Board of Scientific Advice for India

ANNUAL REPORT

FOR THE YEAR

1917-18

CALCUTTA
SUPERINTENDENT GOVERNMENT PRINTING, INDIA
1919

Price 14 As. or 1s. 3d.

Board of Scientific Advice for India

ANNUAL REPORT

FOR THE YEAR

1917-18

CALCUTTA
SUPERINTENDENT GOVERNMENT PRINTING, INDIA
1919

Price 14 As. or 1s. 3d.

Agents for the Sale of Books Published by the Superintendent of Government Printing, India, Calcutta.

IN EUROPE.

Constable & Co., 10, Orange Street, Leicester Square, London, W.C.

Kegan Paul, Trench, Trübner & Co., 68-74, Carter Lane, E.C., and 25, Museum Street, London, W.C.

Bernard Quaritch, 11, Grafton Street, New Bond Street, London, W.

P. S. King & Sons, 2 & 4, Great Smith Street, Westminster, London, S.W.

H. S. King & Co., 65, Cornhill, E.C., and 9, Pall Mall, London, W.

Grindlay & Co., 54, Parliament Street, London, S.W.

Luzac & Co., 46, Great Russell Street, London, W.C.

W. Thacker & Co., 2, Creed Lane, London, E.C.

T. Fisher Unwin, Ltd., 1, Adelphi Terrace, London, W.C.

Wm. Wesley & Son, 28, Essex Street, Strand, London.

B. H. Blackwell, 50 & 51, Broad Street, Oxford.

Deighton Bell & Co., Ltd., Cambridge.

Oliver and Boyd, Tweeddale Court, Edinburgh.

E. Ponsonby, Ltd., 116, Grafton Street, Dublin.

Ernest Leroux, 28, Rue Bonaparte, Paris.

Martinus Nijhoff, The Hague, Holland.

IN INDIA AND CEYLON.

Thacker, Spink & Co., Calcutta and Simla.

Newman & Co., Calcutta.

R. Cambray & Co., Calcutta.

S. K. Lahiri & Co., Calcutta.

B. Banerjee & Co., Calcutta.

The Indian School Supply Depôt, 309, Bow Bazar Street, Calcutta, and 226, Nawabpur, Dacca.

Butterworth & Co. (India), Ltd., Calcutta.

Rai M. C. Sarcar Bahadur & Sons, 90/2A, Harrison Road, Calcutta.

The Weldon Library, 18-5, Chowringhee Road, Calcutta.

Standard Literature Company, Ltd., Calcutta.

Lal Chand & Sons, Calcutta.

Higginbotham & Co., Madras.

V. Kalyanarama Iyer & Co., Madras.

G. A. Natesan & Co., Madras.

S. Murthy & Co., Madras.

Thompson & Co., Madras.

Temple & Co., Madras.

P. R. Rama Iyer & Co., Madras.

Vas & Co., Madras.

E. M. Gopalakrishna Kone, Madura.

Thacker & Co., Ltd., Bombay.

A. J. Combridge & Co., Bombay.

D. B. Taraporevala, Sons & Co., Bombay.

Mrs. Radhabai Atmaram Sagoon, Bombay.

Sunder Pandurang, Bombay.

Gopal Narayan & Co., Bombay.

Ram Chandra Govind & Son, Kalbadevi, Bombay.

The Standard Bookstall, Karachi.

A. H. Wheeler & Co., Allahabad, Calcutta and Bombay.

N. B. Mathur, Supdt., Nazir Kanun Hind Press, Allahabad.

Rai Sahib M. Gulab Singh & Sons, Mufid-i-Am Press, Lahore and Allahabad.

Rama Krishna & Sons, Lahore.

Supdt., American Baptist Mission Press, Rangoon.

Manager, the "Hitavada," Nagpur.

S. C. Talukdar, Proprietor, Students & Co., Cooch Behar.

A. M. & J. Ferguson, Ceylon.

Manager, Educational Book Depôts, Nagpur and Jubbulpore.*

Manager of the Imperial Book Depôt, 63, Chandney Chauk Street, Delhi.*

Manager, "The Agra Medical Hall and Co-operative Association, Ltd." (Successors to A. John & Co., Agra).*

Supdt., Basel Mission Book and Tract Depository, Mangalore.*

P. Varadachary & Co., Madras.*

H. Liddell, Printer, etc., 7, South Road, Allahabad.*

Ram Dayal Agarwala, 184 Katra, Allahabad.*

D. C. Anand & Sons, Peshawar.*

Manager, Newal Kishore Press, Lucknow.*

* Agents for the sale of Legislative Department publications only.

CONTENTS.

Members of the Board of Scientific Advice.

Name.	Appointment.
The Hon'ble Mr. R. A. Mant, B.A., I.C.S.	Secretary to the Government of India (Department of Revenue and Agriculture) and *ex-officio* President, Board of Scientific Advice.
G. T. Walker, Esq., C.S.I., M.A., Sc.D., F.R.S.	Director-General of Observatories.
N. Annandale, Esq., D.Sc., B.A., C.M.Z.S., F.A.S.B., F.L.S.	Director, Zoological Survey of India.
Colonel Sir Sidney Burrard, K.C.S.I., R.E., F.R.S.	Surveyor-General of India.
Colonel H. T. Pease, C.I.E., M.R.C.V.S.	Principal, Punjab Veterinary College.
G. S. Hart, Esq., C.I.E.	Inspector-General of Forests to the Government of India.
J. Mackenna, Esq., C.I.E., M.A., I.C.S.	Agricultural Adviser to the Government of India.
H. H. Hayden, Esq., C.S.I., C.I.E., F.R.S., D.Sc., B.A., B.A.I. (T.C.D.), F.G.S., F.A.S.B.	Director of the Geological Survey of India.
The Hon'ble Major-General W. R. Edwards, C.B., C.M.G., K.H.P., M.D., I.M.S.	Director-General, Indian Medical Service.
The Hon'ble Mr. F. C. Rose, M.I.C.E.	Secretary to the Government of India, Public Works Department.
Sir Alfred Bourne, K.C.I.E., F.R.S.	Director, Indian Institute of Science.
Sir Thomas Holland, K.C.S.I., K.C.I.E., F.R.S., F.G.S.	President, Indian Munitions Board.
Lieut.-Col. A. T. Gage, I.M.S.	Director of the Botanical Survey of India and Secretary, Board of Scientific Advice.

List of Sub-Committees.

Sub-Committee A.—(*Meteorology, Terrestrial Magnetism and cognate subjects*).

1. The Surveyor-General of India (Chairman);
2. The Director-General of Observatories;
3. The Director, Geological Survey of India.

Sub-Committee B.—(*Agricultural Products*).

1. The Director, Botanical Survey of India (Chairman);
2. The Inspector-General of Forests;
3. The Agricultural Adviser to the Government of India.

Sub-Committee C.—(*Soils and Manures*).

1. The Agricultural Adviser to the Government of India (Chairman);
2. The Director, Geological Survey of India;
3. The Inspector-General of Forests.

Sub-Committee D.—(*Forest Products*).

1. The Inspector-General of Forests (Chairman);
2. The Agricultural Adviser to the Government of India;
3. The Director, Botanical Survey of India.

Sub-Committee E.—(*Veterinary Subjects*).

1. The Principal, Punjab Veterinary College (Chairman);
2. The Agricultural Adviser to the Government of India;
3. The Director, Zoological Survey of India.

Sub-Committee F.—(*Libraries*).

1. The Director-General of Observatories (Chairman);
2. The Surveyor-General of India;
3. The Director, Geological Survey of India;
4. The Director, Zoological Survey of India.

Annual Report of the Board of Scientific Advice for India, 1917-18.

SUMMARY OF PROCEEDINGS.

Thirty-fourth meeting held at Simla on the 20th May 1918.

The Board discussed the arrangements of the sections of the Annual Report concerned with Zoological investigations, and approved of a suggestion made by the Director of the Zoological Survey that the bibliography on insects in the Annual Report should be prepared by the Imperial Entomologist.

The programmes for 1918-19 of the various scientific departments were considered and various emendations and additions recommended.

The Board considered a proposal made by Sir Thomas Holland and seconded by Dr. G. T. Walker that a recommendation should be made to Government for the formation of a Drugs Manufacture Committee to investigate the possibilities of the cultivation of medicinal plants in India and the manufacture of drugs from them on a commercial scale. It was resolved to accept the proposal and to recommend its adoption to Government. A note by the Director of the Botanical Survey of India on a suggested enquiry into the possibility of cultivating *Aleurites Fordii* and *Perilla ocimoides* in India as sources of drying oil was discussed. It was resolved to ask the Inspector-General of Forests to arrange for the experimental cultivation of *Aleurites Fordii* and the Agricultural Adviser to the Government of India to arrange for the experimental cultivation of *Perilla ocimoides*.

Thirty-fifth meeting held at Delhi on the 9th December 1918.

The Board considered a memorandum from the Department of Education, Government of India, on proposals to investigate the deterioration in India of paper used for permanent records and publications. The Board expressed the opinion that the proposed investigation was one of great and urgent importance, and recommended to the favourable consideration of Government the lines of investigation adopted at the Indian Institute of Science. It was also suggested that the Institute should be authorised to communicate direct with local Governments in order to collect information regarding the preservation of paper in the principal public and private libraries of long standing, and to circularise libraries with a view of collecting copies of Hamilton's "Journey through Mysore" and other works of a similar kind for comparative examination at Bangalore. It was further suggested that enquiries should be made

regarding the state of preservation of old books in libraries in other tropical countries. With regard to the supply of paper in the immediate future the Board recommended that enquiries should be made from the India Office as to the possibility of obtaining paper for scientific publications more likely to be durable than the paper at present in use.

A reference from the Department of Education, Government of India, regarding the editorship and place of preparation of further volumes of the "Fauna of British India" was discussed. In view of the facts that there is in existence an efficient Zoological Survey of India Department possessing a larger collection of Indian type-specimens than exists elsewhere, and a very extensive library; that the Zoological Survey of India is in touch with official and private workers in Zoology throughout India and consequently can readily arrange for the field investigations so essential to the preparation of an account of the fauna of the country, the Board resolved to recommend that further volumes of the "Fauna of British India" should be prepared under the editorship of the Director of the Zoological Survey of India. The Board recognised that although ordinarily the volumes should be printed and published in India, special circumstances might occasionally make it more convenient for printing and publishing to be done in England.

The Board then considered the draft of its Annual Report for 1917-18, and resolved that in view of the reduction of the summaries of scientific work, bibliographies of departmental and other publications concerned with work done in or for India or having reference to Indian conditions should accompany the sections of the Annual report dealing with Geology and Medical Research for 1917-18 and future years. In other respects the draft was approved subject to the emendation of certain sections in the light of criticisms made at the meeting.

APPLIED CHEMISTRY.

PART I.—AGRICULTURAL CHEMISTRY

BY

W. H. HARRISON, D. Sc.,
Imperial Agricultural Chemist.

SOILS.

Soil surveys.—Ramaswami Sivan reports that the soil survey of the Kistna Delta has been completed and is being prepared for publication, whilst the preliminary work for a survey of the adjoining Godaveri Delta has been carried out.

Finlow has made considerable progress during the past year with the survey of the soils of Bengal. Briefly the soils of Bengal are sharply divided into "*Old alluvium*" (red laterite) and "New alluvium" (silt) which differ widely from each other. In many cases the former are almost sterile and are normally markedly deficient in Ca O. and $P_2 O_5$. $K_2 O$ is also a limiting factor in the case of jute and other fibre crops. The silts normally contain no free lime but are fairly rich in lime salts and $P_2 O_5$ and very often rich in $K_2 O$. The only prominent plant food which is at all deficient is N.

Taylor is carrying out a soil survey of South Bhagalpore.

Alkaline soils.—A point of considerable interest has arisen from the results of potculture experiments at Pusa with the infertile Bara Soils of the Punjab. These soils, which contain a considerable proportion of soluble sulphates and chlorides, were washed with well water, but even after this treatment germination was practically inhibited. An investigation showed that the soluble salts present in the soil had been largely removed, but that a reaction had occurred between the calcium bicarbonate of the well water and the soluble bases of the soil resulting in the formation of alkaline carbonates. This "white" alkali of the soil had in fact been changed into the more toxic "black" alkali. It is therefore of the utmost importance carefully to determine the composition of any water which is proposed to be utilized in the reclamation of the alkaline soils by leaching.

The connection between Soil Deficiency and Plant Disease.—Finlow has drawn attention to facts, that on the red soil tract of Bengal jute is very liable to suffer from Rhizoctonia in the absence of potash manuring and the

incidence of this fungus disease has been shown to be a definite potash starvation, so far as jute and other fibre crops are concerned.

Soil Acidity.—In connection with his studies on certain acid soils of Burma, Warth has determined the power of these soils of absorbing lime from bicarbonate solutions in the presence of CO_2. The lime absorption has been shown, within moderate limits of dilution, to be a function of the quotient lime in solution to CO_2 in solution. The experiments indicated that the method adopted furnished a means of estimating the lime requirements of soils and have shown further that the absorption by the mineral and organic constituents is similar in character.

Soil Investigations in Progress.—Problems connected with the movement of soil water are of great importance in the Punjab on account of the seriousness of seepage from canals and consequent water-logging and they are being studied by Wilsdon along two main lines of investigation :—(*a*) The study of the fundamental laws governing the flow of fluids in porous media with the object of determining the influence of the depth of the water table on the rate of percolation from the soil surface, and (*b*) A study of the movement of water under field conditions necessitated by the importance of estimating the relative parts played by canal water and irrigation water in the rise of the water table.

The same officer has completed an investigation on the rate of nitrification and the influence of the concentration of manure in Punjab soils, but reports that it will probably be necessary to extend the scope of the investigation before it is published. He is also studying the rate of nitrification under fallow conditions.

MANURES AND MANURING.

Ramaswami Sivan has published a report upon the deposits of phosphatic nodules which occur in the Trichinopoly District and describes in considerable detail their occurrence and extent, the method of working them and the composition of the nodules obtained. He has carried out a series of experiments with the powdered nodules which indicate that they will be of great value to the paddy cultivators in the adjoining Tanjore Delta and also that the composting of them with green-mänure or cattle manure leads to increased availability.

The value of green-manures in connection with Ragi (*Eleusine coracana*) has been under investigation for several years by Coleman and the experiments have definitely shown that all the legumes usually grown in Mysore beneficially affect the crop but that the best results are given by cowpea and sunn hemp. The experiments relating to the effect of green-manure on the soil are not completed but so far they indicate that (*a*) ordinarily there is no appreciable permanent enrichment of the soil in nitrogen, (*b*) a small portion of

the nitrogen is lost as ammonia during the first month after application and the loss by seepage into the lower strata does not appear to be considerable. There is however a large proportion of the nitrogen still unaccounted for and this probably is lost in the form of elementary nitrogen and (*c*) the application of either calcic or dolomitic limestone favours nitrification and humus formation and leads to better yields both of the green-manure crop and the subsequent crop of ragi.

Finlow and McLean published a Bulletin on the Water Hyacinth (*Eichornia crassipes*) and its value as a fertilizer. The enquiry has produced definite results in that the preparation of the ash for sale is now widespread and that the only difficulties experienced are in connection with adulteration. A wider outlet for the ash is being sought for.

CROPS.

Crop surveys have been carried out by Wilsdon in the Punjab and Padmanabha Aiyer in the Central Provinces. The latter has completed the determination of the composition of the principal local juars (*Sorghum vulgare*) and Wilsdon is engaged on a survey of the oil seeds of the Punjab, but so far this has been confined to Toria (*Brassica Napus*), Sarson (*Brassica campestris*) and rape seeds. He has also completed a survey of the sugarcanes of the Rohtak District and the results show that the conditions here are much more favourable than in any of the districts previously investigated.

Cyanogenetic Glucosides—Arising out of complaints regarding the poisonous character of occasional cargoes of Burma beans (*Phaseolus lunatus*) Warth and Ko Ko Gyi have carried out an important investigation regarding the occurrence of prussic acid in them and the results obtained have been embodied in a Departmental *Bulletin*. Their general conclusions are :— (*1*) The prussic acid content is an inherited character of pure plant cultures and these cultures may be multiplied and will maintain the difference noted. (*2*) Cultures giving low values in one locality give low values under all the conditions tested. (*3*) The prussic acid present in the cultures varys considerably according to the soil and climate.

The main fact brought out is the possibility of isolating less poisonous strains by chemical selection and in fact the best cultures hitherto obtained contain only one half of the prussic acid contained in the original sample of Madagascar bean imported into Burma as safe for human consumption.

Opium.—Annett has continued his study of the factors influencing the morphine content of opium and has arrived at certain conclusions which will be published in due course.

Sugarcane.—Padmanabha Aiyer has studied the effect of the time of planting on the maturing of the canes under Central Provinces conditions and finds the Sannabile varieties come to maturity in February whatever the time of planting may be.

Finlow reports that tests with sugarcane varieties on the experimental farms of Bengal have shown that an exotic race generally yields higher than the local varieties. Of the varieties tested so far, Yellow Tanna has proved the most satisfactory.

The Louisiana practice of windrowing canes has been studied by Robertson Brown and Harrison under the conditions obtaining in the North-West Frontier Province from December to March. It was found that the weight of the individual cane and percentage of extractable juice decreased considerably during the period of storage but, on the other hand, there had been a corresponding increase in the concentration of the juice and slight increase in its purity, so that this method offers a ready means of storing cane during the inclement months, a point which has an important bearing on the feasibility of manufacturing sugar in this province. The question whether or not there is an actual loss of crystallizable sugar during the storage is more difficult of solution but decided indications have been obtained showing that there is a considerable increase in the case of the Local Pounda cane.

Jute.—Finlow has demonstrated the fact that both lime and potash are limiting factors for jute in the red soil tract and that special manuring has a marked effect on the outturn. He has also investigated "Heart Damage" in baled jute and has published his conclusions in the form of a Departmental Memoir. The damage always occurs in the centre of the bale and is always associated with an excessive moisture content. It is accompanied by a considerable rise of temperature due to the action of thermophilic bacteria in attacking the cellulose with the result that a large proportion of the damaged fibre becomes soluble in water or dilute acids and alkalis and the fibre loses all tensile strength and becomes useless for spinning.

The spice gardens of Kanara have been investigated by Sahasrabudhe who has published a preliminary report as a bulletin of the Bombay Agricultural Department. The enquiries into the nature and cause of the "katte" disease met with in these gardens have had a negative result, but it has been shown that its incidence is not directly associated either with climatic conditions or any defect in the seed or seedlings of the cardamom plants. Neither can it be ascribed to any insect pest, or fungus or bacterial disease whilst the soils are not exhausted and there is no accumulation of injurious salts. More definite results were obtained in regard to the value of the leaf manure used by the cultivators and it has been shown that it is not merely leaf manure which is needed but leaf mould of a particular type.

Safflower.—Mann and Kanitkar have compared the properties of safflower oil as expressed and also after heating under well defined conditions and have arrived at the conclusion that only at temperatures in the neighbourhood of 300°C and in the presence of oxygen does the change to the "Roghan" of the Indian bazaars occur. They consider the change to be largely in the nature of decomposition with some polymerization and only to a minor extent

due to oxidation. The behaviour of these heated oils when admixed with "driers" was studied in detail and the results point to the conclusion that they can be employed as drying oils in certain branches of Technology.

Sugar from Date Palms.—Mann and Patwardhan have been engaged in an attempt to manufacture a good quality jaggery from the date palm. They found that the dark colour of the product was due to considerable alkalinity in the juice and that partial neutralization with citric acid resulted in the production of a fine yellow jaggery of good taste and grain. The addition of larger proportions of the acid tended to give rise to a soft product.

Plant Nucleic Acids.—Clarke and Prof. Schryver have published in the Biochemical Journal a paper describing new methods for the preparation of these physiologically important bodies which are the chief constituents of the nucleus of plant cells. Biological experiments with nucleic acids have been retarded hitherto owing to the difficulty of preparing them and their decomposition products in sufficient quantity and the discovery of these simple methods of preparation, which can be applied to all vegetable tissues, will render important biological work possible.

Miscellaneous.—In connection with the Madras Exhibition of 1917 the Madras Agricultural Chemist and his staff have paid considerable attention to the possibility of utilizing indigenous material for the preparation of foodstuffs hitherto imported in considerable quantities. They have been successful in preparing excellent examples of "shredded wheat", "Grape nuts", Vermicelli and Macaroni and have shown that flours prepared from South Indian leguminous seeds form a good substitute for pea flour.

The most important fact they have brought out is that certain grains such as ragi (*Eleusine coracana*) and Cholam (*Sorghum vulgare*) are capable of producing excellent malts which can be used as a basis for preparing infants and invalid foods of the types of the well-known Bengers aud Mellins Foods. In addition a good malt extract can be readily prepared from them and used for the production of "Malted milk."

Visvanath has investigated the best season for the lifting of cus-cus roots (*Andropogon muricatus* Retz.) on the West Coast and concludes that roots lifted about the end of March give the greatest output of oil.

APPLIED CHEMISTRY.

PART II.—FOREST CHEMISTRY.

BY

C. E. C. COX,

Assistant Forest Economist and Officer-in-charge, Forest Chemist's Office, Forest Research Institute.

The following represents a brief summary of the more important work done in the Chemical Branch of the Forest Research Institute during the year 1917-18.

(I). ESSENTIAL OILS AND OLEO-RESINS.

Distillation of Cymbopogon species from Burma.—A further consignment of the flower heads of this grass was received from the Divisional Forest Officer, Mandalay. The grass was distilled and the oil thus obtained was examined with the following results :—

Description.	Moisture per cent.	Oil per cent.	Oil calculated on dry material per cent.	Description of oil.	Sp. Gr. at 15° C.	Refractive Index at 30° C.	Angle of rotation in 10 c. m. tube.	Acid No.	Saponification No. before acetylisation.	Saponification No. after acetylisation.	Free alcohols calculated as geraniol.	Soluble in 70 per cent. alcohol.	Soluble in 80 per cent. alcohol.
Cymbopogon grass from Mandalay. (only flower heads.)	9·40	0·10	0·11	Yellowish Brown Oil.	0·9428	1·486	+47° 27′	0·67	26·3	217·9	61·5 per cent.	1·8 parts.	0·3 part.

From the above it is evident that this grass is similar to *Cymbopogon clandestinus* Stapf, previously received from Maymyo.

Camphor and Camphor Oil.—A sample of camphor clippings consisting of leaves and tender shoots was received from the Conservator of Forests, Cochin State, an examination of which yielded the following result :—

Description.	Loss at 100° C per cent.	Dry camphor per cent.	Camphor Oil per cent.	Total volatile Oil per cent.	REMARKS.
Camphor clippings consisting of tender shoots and leaves. (Large scale trial charge 40—50 lbs.)	11·14	1·70	0·29	1·99*	* These figures represent the average of two charges.
Camphor clippings consisting of tender shoots and leaves. Laboratory scale (to determine total volatile matter).	11·14	...	...	2·13	

This sample is richer in camphor content than any other sample of leaves collected up-to-date from various localities of India and Burma. The percentage of camphor in this sample is also sufficiently high to justify exploitation on a commercial scale.

(II). TANNIN.

Cassia siamea pods, leaves and bark.---Pods, leaves and bark of *Cassia siamea* were examined. The pods were found to contain 10·27 per cent. of moisture and 6·08 per cent. of tannin; the leaves 12·00 per cent. of moisture and 7·17 per cent. of tannin and the bark 15·42 per cent. moisture and 8·74 per cent. of tannin. The percentage of tannin in all of these samples is too low to be utilized as a tanning agent alone, though it may be found possible to utilize it in admixture with richer tanning materials.

Betelnut juice.—A sample of betelnut juice was examined with the following results:—

	Per cent.
Moisture	60·41
Ash	2·61
Total solids	39·62
Insolubles at 14-15° C	5·68
Total soluble solids	33·94
Non-tannin	5·42
Tannin	28·52
Tannin calculated on dry material	72·03

The juice is very rich in tannin and comparatively low in non-tannin. It would thus be a very useful tanning agent provided the cost of the raw material is not excessive and if concentrated further in vacuum pans to reduce the percentage of moisture it would doubtless make a valuable tannin extract for export to other countries.

(III). MISCELLANEOUS.

Vegetable tallow from Sapium sebiferum seeds.—The tallow tree *Sapium sebiferum*, indigenous and cultivated in China and Japan, is also found to thrive in the United Provinces and the Punjab. The cultivation of this plant was originally abandoned because a preliminary experiment on the extraction of the tallow from the seeds showed that it would not be remunerative to collect the seeds and extract the fat from them. Prompted by the fact that the preparation of tallow from this seed is known to be a remunerative business in China and also by the frequent enquiries received on this subject it was considered advisable to institute a further enquiry as to the possible utilization in India of this seed.

It was found that the solid fat embedded in the white albuminous coating of the seeds amounted to 23·31 per cent. and that the inner kernels contain 20·20 per cent. of a drying oil similar to linseed oil. In China the seeds are bruised and then boiled or steamed, whereby the fat separates from the albu-

minous coating and floats on the top of the water. By this process only about 50 per cent. of the fat is recoverable. In order to make the extraction of the fat and the oil a profitable undertaking the seeds must be extracted with a solvent of the type of "Trichlore thylene" or petroleum benzine, etc. The solvent extraction process has now been brought to such a degree of perfection that only 5 per cent. of the solvent per 100 parts of the material-extracted is lost. Hence it appears that the cultivation of *Sapium sebiferum* in India should be encouraged as it appears probable that an industry based on the solvent extraction of the fat would prove a remunerative one. A note on this subject is about to be published in the *Indian Forester.*

Sapium sebiferum leaves.—It is said that the leaves of *Sapium sebiferum* yield a black dye, but a preliminary examination of the autumn leaves showed that this is not the case. The composition of the leaves was as follows :—

——	1st lot with fresh leaves.	2nd lot fresh leaves turned nearly all red.
	Per cent.	Per cent.
Moisture	48·84	53·14
Total solids or aqueous extract	12·88	19·76
Non-tanning matter	10·05	15·62
Tanning matter	2·83	4·14

The tan liquor gives no re-action with bromine water and with lime-water gives a dirty greenish precipitate. Ferrous sulphate gives a blue-black and ferric chloride a greenish black precipitate. The presence of a dye therefore could not be detected.

The shade dried leaves when treated with lime gave off ammonia which was accordingly estimated as amounting to 0·21 per cent. of the shade dried leaves containing 13·66 per cent. of moisture. These leaves should therefore make an excellent manure and experiments might well be made on them in this connection.

Roots of Flemingia vestita.—The roots of *Flemingia vestita* were examined with the following result :—

	Per cent.
Moisture	59·06
Ash	0·91
Cold water solubles (consisting of gum pectous and albuminous matter, etc., both glucose and cane sugar being absent)	10·14
Insolubles, fibrous matter, etc.	3·90
Starch	25·99

The starch granules when examined under a microscope showed a similarity in appearance to those of maize. The percentage of starch is very high and compares very favourably with potato which contains 16·24 per cent. of starch with moisture 75·48 per cent. The starch gelatinizes well and should be a satisfactory material for the production of all kinds of industrial pastes and also as a substitute for gums.

Strychnos Nux Vomica wood.—*Nux Vomica* wood was reported to be immune to the attacks of white-ants, borers, etc., owing to the presence of the alkaloids. Hence a piece of wood containing 9·70 per cent. of moisture was assayed for alkaloid content. As a result it was found that the crude alkaloids amounted to :—

	Per cent.
Strychnine	0·49
Brucine	0·75

A suggestion has been made that other soft woods may be impregnated with an acid solution of these alkaloids to render them immune to the attacks of white-ants, borers, etc. It will be seen from the analysis given above that the wood contains a fair percentage of strychnine and brucine.

All the above investigations, with the exception of those relating to Cymbopogon, Camphor and Strychnos, were carried out by Mr. Puran Singh, Chemical Adviser to this Institute.

The experiments with Cymbopogon, Camphor and Strychnos were carried out by Mr. T. P. Ghosh, Assistant to the Chemical Adviser.

ASTRONOMY

BY

GILBERT T. WALKER, C.S.I., M.A., Sc.D., F.R.S.,

Director-General of Observatories.

Solar physics.—Researches in solar physics are carried on under the direct control of the Government of India at Kodaikanal, the Director being Mr. J. Evershed; the Assistant Director Dr. T. Royds has joined the Indian Army Officers Reserve. The chief instruments are :- -

(*a*) A spectroheliograph made by the Cambridge Scientific Instrument Company, the object of which is to take photographs of the sun using the light emitted by one chemical element only. In this apparatus a stationary image of the sun is made by a 12-inch triple-achromatic lens of 2(-foot focus, fed by an 18-inch Foucault siderostat. Close up to the image and somewhat longer than its diameter is the narrow vertical slit of a spectroscope arranged in such a manner that the light which has passed horizontally through the collimating lens shall be deflected through two right angles by two prisms and a mirror, and so shall emerge from the camera lens parallel to its original direction. This light then falls upon another vertical slit which can be adjusted in such a position as to allow light of any desired wave length to pass through. In the Kodaikanal spectroheliograph the collimating and camera lenses each of 5-inch aperture and 6-foot focal length, together with the prisms and slits, are attached to a rigid framework, while immediately in contact with the slit last described is a stationary photographic plate within a fixed camera. The rigid framework is capable of motion in a horizontal plane in such a manner that the primary slit may pass uniformly across the image of the sun while the secondary slit will move at an equal rate across the sensitised plate ; and as in each position an image will be formed at the second slit by light of the desired wave length and no other light can emerge, the result of the movement upon the plate is a complete image of the sun in monochromatic light. At present the H and K lines of calcium are largely used on account of the convenience afforded by the width of their absorption shading and the fact that the centre of the dark line is frequently " reversed," *i.e.*, is bright instead of dark indicating that the calcium vapour is abnormally hot in the higher levels of the solar envelope. A photograph so obtained shows bright clouds called " flocculi " of calcium

vapour scattered about over the sun, and gives a large amount of information that is not otherwise obtainable. Further, by causing the slits to move more slowly the exposure may be lengthened sufficiently to give photographs of the "prominences" projecting from the sun's margin.

(*b*) An autocollimating spectroheliograph built in the observatory workshop. This is attached to the side of the Cambridge instrument and shares in the very perfect transverse movement of the latter. It is designed for photographing the sun's disk in the hydrogen line C. A large grating is used to obtain the highly dispersed spectrum which is necessary in photographing with this line.

(*c*) A high dispersion spectrograph mounted on piers in the spectroheliograph room. This is fitted with special arrangements for rotating the sun's image on the slit plate, and for accurate guiding during long exposures on sunspots or prominences. A special device has also been added for photographing simultaneously the spectrum of an electric arc on either side of a solar spectrum. A grating by Anderson with 5 inch ruling is usually employed.

(*d*) A 6-inch equatorial refractor with large grating spectroscope attached is used for the study of sunspot and prominence spectra by visual methods. The equatorial mounting and spectroscope are from the Maharaja Takhtasingji Observatory, Poona.

(*e*) The 15-inch Hyderabad lens is in use for photographing the spectrum of Venus, and for sunspot spectra.

(*f*) The Poona 6-inch photovisual lens has been used for the daily series of direct solar photographs, and for spectrum photographs of Nova Aquilæ.

(*g*) A new grating spectrograph utilizing the Rowland 3-inch grating for sunspot spectra has been erected in the spectroheliograph room.

Routine Work.—Daily spectroheliographic records are obtained in calcium and in hydrogen light; the routine work also includes visual examination of sunspots and faculae, sunspot spectra, and bright lines or displaced lines in spots and in prominences. A monthly article describing the solar activity is contributed to the "Monthly Weather Review" while for more technical purposes bulletins and memoirs of the Observatory are issued. Of the former 58 have appeared and of the latter 2.

Spectroscopic Investigations.

1. A series of solar rotation plates was secured during a favourable spell of weather in February and March 1918; these are confined to a limited region

of the spectrum including the hydrogen line in the red. The plates have mostly been measured, using the positive on negative method, and the results confirm values previously obtained for the equatorial speed of rotation which gave results 2 or 3 per cent. smaller than was found at Mount Wilson in 1906 to 1908.

2. A series of solar spectra with carbon arc for comparison was obtained in order to measure the displacement of the cyanogen bands near 3883 both at the limb and the centre of the disc. The lines in these bands, or series of triplets, are not subject to pressure shifts and are therefore suitable for discovering whether the sun's gravitational field affects the wave-lengths of the lines according to Einstein's theory of relativity. The preliminary result of the measures shows that the lines share in the general shift of the metallic lines in the sun towards red, but the shift at the limb where motion in a radia direction would not affect the result is only about one half the expected gravitational shift. This result has been communicated to "The Observatory" for publication.

3. The research on the wave-length of the lines in sunlight reflected by Venus has been continued. A series of Venus and Fe arc spectra was secured in October and November 1917 with the planet an evening star; again in April, June, and July 1918 with the planet a morning star. Those of November and April near east and west elongations respectively give the greatest displacements due to the relative motion of planet and earth, and serve to determine this motion with considerable accuracy. Hence a value of the solar parallax can be derived if the results are not affected, as is possible, by a rapid rotation of the planet. It is hoped to determine from these plates whether the planet rotates with the same order of velocity as the earth or very much slower. The July plates were obtained under very favourable skies and should yield the information sought regarding the wave-length of the solar lines in a hemisphere of the sun turned 90° or more from the earth.

4. Prismatic camera spectra were secured of Nova Aquilæ, using the 6-inch Poona prisms and the 6-inch photovisual lens. Good spectra were obtained on 8 days in June and 5 days in July 1918. By a special arrangement of the apparatus it was made possible to place the spectrum of Arcturus accurately alongside of the Nova spectrum so that the wave-lengths of the Nova lines could be read off from the known Arcturus lines. By this means estimates of displacement of the absorbing hydrogen lines in the Nova in June gave a velocity of approach of nearly 1800 kmlsec, which is the same order of velocity as found in Nova Persei in 1901. The latest spectra obtained show that the absorption lines have disappeared and the emission line 5007 characteristic of nebulæ has increased in relative brightness compared with the hydrogen emission lines. These changes are also in accordance with precedent.

METEOROLOGY

BY

GILBERT T. WALKER, C.S.I., M.A., Sc.D., F.R.S.,
Director-General of Observatories.

Upper Air.—The work with pilot balloons observed by theodolites was continued in North India at Agra, Simla and Kojak, and for South India at Bangalore, where the work is in the hands of the Meteorological Officer of the Mysore State and has been carried out with admirable zeal and accuracy. The trajectories to standard scale of the paths of all balloons are charted for determination of normal and abnormal conditions of wind strength and direction at all heights reached, *i.e.*, up to 10 or 11 kilometers. The number of these records now available is sufficient to provide a useful basis for a preliminary estimate of normal conditions for the various seasons of the year.

Investigation of thermometer sheds.—In order to secure a pattern of standard shed that was not easily inflammable comparisons have been made at Agra between (*a*) a tiled shed, (*b*) a tiled shed lined with wood, (*c*) a Stevenson's screen, and (*d*) a standard shed. These brought to light discrepancies between air temperatures given by thermometers which had been compared in water ; these depended on the dimensions of the bulbs and on the shape of the slab of wood to which the thermometer was attached. The experiments were brought to an end before completion by Mr. Field's return to England in May 1918.

Seasonal forecasting.—It had been found in 1916 that the pressure distribution of India during May had a negligible effect on the subsequent distribution of monsoon rainfall of India, and the question arose whether a forecast for the geographical distribution during the second half of the monsoon period could be derived from (*a*) the pressure distribution of India in July, (*b*) the pressure conditions of June and July in South America and the Indian Ocean. It was found that fairly close relationships existed and the analysis will be published at the end of the war.

TERRESTRIAL MAGNETISM

BY

GILBERT T. WALKER, C.S.I., M.A., Sc.D., F.R.S.,

Director-General of Observatories.

Magnetic observatories.—Bombay (Alibag).—The Bombay Observatory, formerly maintained by the Local Government at Colaba, was moved to Alibag in consequence of the introduction of electric trams into the city. It is now directly under the Government of India, the Director being Dr. N. A. F. Moos. For a description of the instruments and of the routine work reference should be made to the Annual Report of the Director.

Magnetic Survey.—The magnetic observatories at Dehra Dun and Toungoo were inspected by the officer in charge during the field season and a complete set of observations was taken at each for the comparison of instruments. The Alibag and Kodaikanal observatories, under the Meteorological Department, were also visited for the same purpose.

Galle, a seaport town in the south of the island of Ceylon, was visited for the purpose of establishing a permanently marked repeat station which was much needed for obtaining a better determination in future of the annual changes in the magnetic elements in that region where the data in this respect were insufficient. With the cordial assistance of the Surveyor General of Ceylon a suitable site was selected near the north-eastern bastion of Galle Fort and observations of the three magnetic elements were taken at a permanent traverse mark of the Ceylon Survey.

No other field observations were taken during the year.

In 1919-20 the 75 repeat stations in India and Ceylon will be revisited. Favourable reports of good preservation of the permanently marked repeat stations continue to be received from the local officials annually so that it will be possible in future to occupy the exact sites and it is hoped in consequence that the secular changes will be obtained with even greater accuracy than in the past.

Publication of the results of the Magnetic Survey.—The scheme of the magnetic survey originally decided upon consists of a general survey and a detailed survey of magnetically disturbed areas.

The general survey comprises observations of declination, dip and horizontal force at 74 repeat stations and 1,351 field stations in India and Ceylon observed at from 1901 to 1915: the reduction of these observations to the epoch 1909-10 has been completed and is now in course of publication. The publication will contain particulars of the work at the observatories and field

stations, the instruments in use, etc. and will consist of tables of the three magnetic elements at the observatories and repeat and field stations and of the annual changes of the elements at each; also tables of the total force and of the three rectangular components. The volume will contain maps showing the lines of equal declination, dip and horizontal force and the lines of equal annual change, and will also include illustrations of the magnetic instruments. The maps will show the true course of the isomagnetic lines as obtained from actual observations, corrected for normal diurnal variation, short-lived disturbances and annual change, and reduced to the selected epoch. No attempt has been made to smooth out the irregularities in the curves of the true isomagnetics due to the magnetically disturbed nature of certain areas.

The detailed survey will not be included in the publication of the results of the general survey. The reduction of the detailed survey is however in hand and the investigation of the results to determine the direction and intensity of the magnetic forces, which may perhaps disclose the existence of some special magnetic features in the areas surveyed in detail, will be published later as a supplementary piece of work.

The magnetic elements at observatories.—The computation and tabulation of the provisional values of declination, dip, horizontal force and vertical force for the three observatories (Dehra Dun, Toungoo and Kodaikanal) for 1917 have been completed; the mean values of these elements for the year 1917 derived from all days, excluding those of great disturbances, are given in the table given below.

Observatory.	Latitude and Longitude.	Dip.	Declination.	H.F.	V.F.
	° ′ ″	° ′	° ′	C.G.S.	C.G.S.
Dehra Dun ...	30 19 19 N 78 3 19 E	N. 44 44·1	E. 2 6·5	·33010	·32704
Toungoo ...	18 55 45 N 96 27 3 E	N. 23 8·5	W. 0 12·7	·39037	·16684
Kodaikanal	10 13 50 N 77 27 46 E	N. 4 27·1	W. 1 33·8	·37661	·02931

GEOLOGY

BY

H. H. HAYDEN, C.S.I., C.I.E., F.R.S., D. Sc., F.G.S.,

Director, Geological Survey of India.

Mineralogy.—The more interesting mineral specimens received during the year were—

(1) an intergrowth of gold crystals found in a mercury riffle at the Kolar gold field;

(2) gold with tetradymite from North Anantapur;

(3) samarskite in quartz from near Bangalore;

(4) monazite from the pitchblende-bearing pegmatites of Singar in the Gaya district.

Meteorites.—Two meteorite falls were recorded in 1917: the first at Ranchapar in the Sonthal Parganas, and the second at Cranganore in the Cochin State. Of the latter, six fragments were received weighing altogether nearly 1,460 grammes; the stone is a veined white chondrite.

Palaeontology and Stratigraphy.—The researches carried out in the previous year were continued during the year under review; two of those, the examination and description of Palæozoic fossils from Chitral and the Pamirs and from Yunnan, were completed, and the results submitted for publication.

Considerable interest was aroused by the reported discovery of Upper Palæozoic fossils in a limestone in the neighbourhood of Solon. The identification of the specimens, however, was by no means beyond dispute, and it is still regarded as not improbable that the limestone in question may have been derived from the Tertiary rocks known to occur in the neighbourhood. The matter is receiving further investigation.

Geological Surveys.—The geological surveys of Tavoy, Mergui and Amherst districts were continued during the year, that of Tavoy being practically completed. In Rajputana certain gaps in the geological map were filled in, and similar work was carried out in the Central Provinces.

Economic Enquiries.—Investigations were made regarding the following minerals: antimony in Amherst and the Southern Shan States, bauxite in Chota Nagpur, lead in Northern Burma, mica throughout India, molybdenite in Madras, petroleum in the Punjab, potash salts in the Punjab and tungsten in Burma.

GEODESY.

BY

COLONEL G. P. LENOX-CONYNGHAM, R.E., F.R.S.,

Superintendent of the Trigonometrical Survey.

TRIANGULATION.

Punjab.—The only triangulation done during the year 1917-18 consisted of some series, in character midway between geodetic and minor, that were carried across the Sind-Sāgar Doāb in order to provide a framework for the rectangulation of that area, in connection with the great Indus-Jhelum Irrigation scheme. As, however, the points were sufficiently well fixed to permit of their being used as latitude and longitude stations should such be required in this region, the work may, without impropriety, be mentioned in this report.

The total number of stations fixed was 111. The average length of the sides of the triangles was 7·8 miles.

The observations were made with 6-inch Micrometer theodolites, the objects observed being (1) helios, when practicable, (2) opaque signals from 10 to 35 feet high, and (3) ordinary hurricane lanterns raised to a height of about 4 feet above the station marks.

Owing to the high refraction at night, it was found that hurricane lanterns, slightly raised, were clearly visible even in cases where lofty signals were necessary during the day.

Four observers were employed and their average triangular errors were 2, 3, 2, and 2 seconds respectively, the general average for the whole being 2 seconds.

The total length of the chains of triangles was about 375 miles.

The triangulation was connected with five sides of the Great Indus Series of the Principal Triangulation and the greatest corrections that had to be applied to the coordinates of any point in the process of adjustment were 0"·30 in latitude and 0"·30 in longitude.

The figure of merit M of the series calculated according to the formula devised by Mr. J. de Graaff Hunter, which is given in the records of the Survey of India, Volume IX, page 138, is 3·31, which places the work on an equality with some of the geodetic triangulation.

LEVELLING OPERATIONS.

During the year 1917-18 the following lines of precise levelling were run :—

(*a*) **In Bengal.**—(*i*) Revisionary levelling from Barakar to Burdwān *via* Asansol, along the Grand Trunk Road. This line forms part of the line from Benares to Burdwān.

(*ii*) Revisionary levelling of part of the line from Aurangābād to Barākar, *i.e.*, from the junction of the Purūlia-Barākar road with the Dāmodar river to Barākar.

(*b*) **In Bihar and Orissa.**—(*i*) Revisionary levelling from Karamnāsā to Aurangābād, along the Grand Trunk Road. This line forms part of the line from Benares to Burdwān.

(*ii*) Revisionary levelling from Rānchī to the Dāmodar river, *via* Silli, along the main road. This line forms part of the line from Aurangābād to Barākar *via* Daltonganj, Rānchī and Purūlia.

The above revisions were undertaken in order to try and locate the large discrepancy of about 2 feet on the Benares-Howrah Line and that of about 1 foot on the Rānchī-Barākar Line. These revisions do not disclose any grave error in the original levelling operations. The matter is still under investigation.

(*c*) **In the United Provinces.**—(*i*) New levelling from Cawnpore to Jhānsi *via* Kālpī and Orai, along the main road. Small branch lines connecting Gora G. T. Tower Station and several rock-cut protected bench-marks were also run.

The total out-turn of levelling including branch-lines amounted to 423 miles, *viz.*, 273 miles of revisionary and 150 miles of new levelling.

TIDAL OPERATIONS.

Tidal registrations by means of self-registering gauges have been carried out during the year at the ports of Aden, Karāchi, Apollo Bandar (Bombay), Prince's Dock (Bombay), Madras, Kidderpore, Rangoon, Moulmein and Port Blair.

All the observatories were inspected during the year and the tide gauges were thoroughly overhauled, cleaned and put in working order.

In addition to the automatic tidal registrations at the nine stations named above, readings of high and low water were taken during day-light on tide poles at Bhavnagar, Chittagong and Akyab. The object of these observations was to test the accuracy of the tidal predictions, which are based on system at a tidal observations taken many years ago.

Tidal readings taken on a tide-gauge at Basrah were supplied to this department by the Director of Inland Water Transport, Mesopotamia, during the past year. As mentioned in the last year's report, arrangements were made to prepare tide-tables for Basrah, and data for the same were transmitted

to the National Physical Laboratory in England. Predictions for the period from September 1917 to end of December 1918 were received from the Laboratory on 6th August 1917. With this material tide-tables for Basrah were printed in the office of the Trigonometrical Survey at Dehra Dun and supplied to the Director of Inland Water Transport on 3rd September 1917. The Director has since reported that the tide-tables supplied to him are proving most serviceable. Comparisons of the actual with the predicted times and heights are being made and, as was to be expected at a port so far from the open coast and so liable to be affected by the conditions of the river, considerable discrepancies have been found. The Director of Inland Water Transport is equipping some of his stations with meteorological instruments and it is to be hoped that the connection between the observed discrepancies and the meteorological conditions may be traced and in future to some extent eliminated.

BOTANY.

I.—BOTANICAL SURVEY.

BY

A. T. GAGE, Lt.-Col., I.M.S.,

Director, Botanical Survey of India.

Eastern India.—Mr. H. G. Carter, Economic Botanist to the Survey, made a short tour in March 1918 in the Khasia and Jaintia Hills districts of Assam, giving his attention more particularly to the economic plants of these districts. Rai Upendranath Kanjilal, Bahadur, continues his work on the Forest flora of Assam. Mr. P. M. Debbarman of the Botanical Survey collected in Tipperah and enlisted the aid of the Forest officers in that state in obtaining collections from areas that he could not personally explore. From the collections made some years ago by Mr. Kingdon Ward in Upper Burma quite a considerable number of new species have been published by Messrs. W. W. Smith and W. G. Craib both formerly of the Royal Botanic Garden, Calcutta, and now of Edinburgh. So also the collections made in Bhutan by Mr. R. E. Cooper (now of the Royal Air Force) continue to yield a crop of new species.

Northern India.—The most important contribution during the year to the systematic knowledge of the flora of this area is Mr. R. N. Parker's Forest Flora of the Punjab. Mr. S. R. Kashyap has published further results of his studies of the Liverworts of the Western Himalayas and the Punjab, and has added six new species to those already described by him. Mr. J. S. Gamble has published a lucidatory note on the Himalayan species of *Skimmia*.

Western India.—Messrs. Saxton and Sedgwick's account of the vegetation of Northern Gujarat has appeared in the Records of the Botanical Survey. Mr. Sedgwick has also recorded observations on the monsoon flora at Castle Rock, and published a paper on the *Cyperaceæ* of the Bombay Presidency. The Rev. Father E. Blatter, S. J., and Professor Hallberg have made a contribution towards the Flora of Persian Baluchistan and Makran. A list of the plants of Arabia has also been prepared by the former, and will appear in the Records of the Botanical Survey.

Southern India.—Mr. Gamble in the course of working up the material for his Flora of Madras Presidency has published a series of new species from South India. Mr. C. E. C. Fischer, I.F.S., who has for many years given notable aid to the work of the Botanical Survey has paid special attention to

the vegetation of the Anaimalai Hills, and a systematic account of it will appear in due course. The Rev. Father Blatter has made a botanical exploration of the High Wavy Mountain of Madura, and published a preliminary note on its vegetation. Mr. C. Tadulingam, Government Lecturing Botanist, Madras, made a general botanical survey of several districts of the Madras Presidency. Mr. P. F. Fyson has studied the ecology of the flora of the Nilgiri and Pulney plateaus.

General.—The Rev. Father Blatter continues his important work on the Palms of India and Ceylon and the 19th and 20th instalments concerned with the Lepidocaryeæ Palms have appeared. The same botanist in conjunction with Professor Hallberg has published a revision of the Indian species of *Rotala* and *Ammannia* and a paper on new Indian *Scrophulariaceæ* wherein four new species are described. Mr. G. B. Patvardan has recorded his observations on the interchangeability of vegetative and fruit structures in *Opuntia elatior* and a sport of that species. Mr. P. M. Debbarman has written a paper on a teratological condition of *Allium Cepa* and another on the functions of the pitchers of *Dischidia Rafflesiana*. Sir David Prain has published a historically and scientifically erudite account of the difficult genus *Chrozophora*. Captain A. W. Hill has published an important account of the genus *Strychnos* in India and the East, in which he describes twenty-two new species bringing the known species of this genus in the East to a total of ninety-two. Mr. J. Hutchinson has published a revision of the genus *Aspidopterys* in which a new species from the Andamans is described, and several obscure points cleared up. He has also revised the species of the general *Taxotrophis* and *Balanostreblus*, and described a new species of the former from Burma and Assam. An account of the species of *Oxalis* now wild in India and description of a new *Vernonia* by Mr. C. C. Calder and a paper on *Trichodesma indicum* and *T. amplexicaule* and descriptions of a new Balsam and a new orchid by Mr. L. J. Sedgwick are in the Press for issue in the Records of the Botanical Survey. Mr. P. F. Fyson has contributed a monograph of the genus *Eriocaulon* for publication in the Records of the Botanical Survey. Signor Beccari's monograph of the species of Lepidocaryeæ Palms, other than those of the genera *Calamus* and *Daemonorops*, is about to issue from the Bengal Government Press. Other papers of minor importance are mentioned in the appended bibliography.

BOTANY

II.—ECONOMIC BOTANY.

Part I.—Agricultural Botany.

BY

ALBERT HOWARD, C.I.E., M.A., A.R.C.S., F.L.S.,

Imperial Economic Botanist.

The present report, which is confined to four pages of print, deals with the progress of Economic Botany in India during the year ending June 30th, 1918. Under these conditions as regards space, the best course would appear to be to limit this paper to an account of the more important advances made during the year and to refer the student of Indian agriculture to the various other annual reports published by Government which cover the same subject but in greater detail.

In addition to the list of papers on Economic Botany appended to this report, the following annual publications contain a considerable amount of information on the improvement of crops :—

(a) *Report on the Progress of Agriculture in India.* This is an annual report, prepared by the Agricultural Adviser to the Government of India, Pusa, Bihar, and deals, among other matters, with the distribution of improved seed in the various parts of India. To avoid overlapping, detailed references to seed distribution schemes have been omitted in the present report.

(b) *Scientific Reports of the Agricultural Research Institute, Pusa* (including the Report of the Imperial Cotton Specialist). Copies can be obtained from the Director, Agricultural Research Institute, Pusa, Bihar.

(c) *Administration reports of the Provincial Departments of Agriculture*—Bombay, Bengal, Madras, Central Provinces, United Provinces, Punjab, Bihar and Orissa, Assam and Burma. These are issued by the Government presses in these provinces towards the end of each year and contain a general summary of the work of the Agricultural Department (including the farm reports), and also the annual reports of the Economic Botanists. These administration reports largely form the basis of the annual *Report on the Progress of Agriculture in India.*

(d) *Proceedings of the Board of Agriculture in India.*—This contains the programmes of work in progress in Economic Botany as well as discussions on matters relating to the Agricultural Department as a whole. Copies can be obtained from the Agricultural Adviser to the Government of India, Pusa, Bihar.

Soil aeration.—Perhaps the most significant advance in recent years in the study of the principles underlying crop production is the growing recognition of the importance of vegetable physiology in this branch of agriculture. This is naturally leading experiment station workers to take a broader view of problems relating to the improvement of crops, to study, in detail, the various growth factors involved and to determine which of these are likely to be in defect and so limit production. During the past year, the importance of the soil aeration factor in Indian agriculture has been definitely established and this opportunity is taken of summing up the present position.

If growth is influenced by the aeration of the soil, the effect of this factor will be apparent in any series of cultures where all the conditions are uniform except the ventilation of the roots. A number of careful investigations have recently been carried out on this point, which were described in a lecture delivered to the Indian Science Congress at Lahore during the present year. At Pusa, for example, the addition of inert aerating materials such as potsherds or sand increased the growth of indigo as much as 40 per cent., while at Quetta, fine desert sand improved the growth of lucerne in the local soil still more. Soil aeration has been proved to be one of the factors on which the growth of crops depends and is also concerned in the full development of quality. Mr. Hole's results at Dehra Dun and at other places show that soil aeration is equally important in Indian forestry.

In Indian agriculture, the aeration of the soil is often defective over wide areas both in the rains and also during the cold season. The operation of this factor has been found to be of particular importance on the alluvial soils of the Indo-Gangetic plain which are watered by canals. Flood irrigation, as practised by the cultivators, by destroying the porosity of these soils and by leaving a surface crust largely impervious to air, removes one limiting factor — the want of water — but simultaneously introduces another — need of aeration. Consequently, when the canals provide water in abundance in desert regions like the Canal Colonies of the Punjab, the cultivator invariably over-reaches himself and oversteps the point at which soil aeration becomes more important than an increase in the water supply. He not only wastes water but also depresses the yield. Experiments carried out at Gungapur in the Lyallpur District show that at least one-third of the irrigation water used for wheat is wasted and does more harm than good. Still more striking results have been obtained by Mr. Main on the fine alluvial soils of Sind at Mirpurkhas where very high yields of wheat (in one case as much as

2,062 lb. to the acre) were obtained on the preliminary irrigation only. In this connection, Mr. Main considers that soil aeration is an important factor underlying the practice of Sind fallows under which the soil is cropped only once in three years. "Observation indicates that land exhaustion in Sind is largely a physical problem, in other words, the irrigation damages the texture of the soil and produces a condition wholly unfavourable to useful biological action through the exclusion of air. In the process of a long fallow, the texture of the soil recovers and nitrification proceeds satisfactorily; thus crops in Sind grown after a long fallow are very remarkable for their deep green foliage which is more vivid than that of crops grown annually with the aid of manure."

The results obtained by Mr. Clouston at Chandkhuri in Chhattisgarh and by Mr. Allan at Nagpur show that soil aeration is equally important on many of the soils of Peninsular India. At Chandkhuri, Mr. Clouston has discovered that the poor laterite soil known as *bhata* which formerly was considered to be below the margin of cultivation is in reality of great potential value in the future development of India. Although poor as regards chemical composition, the physical texture is such that it ensures good drainage, good aeration and oxidation, conditions of special advantage for nitrification. Manure applied under these circumstances is utilized to the best possible advantage. Under irrigation, crops of sugarcane over 40 tons to the acre and entirely free from the red-rot disease have been obtained. Groundnuts have done equally well and Java indigo, which always responds to improved soil aeration, has produced abundant seed and grown much better than on the richer but less porous black soils. Although the rainfall at Chandkhuri is above 50 inches, cotton has done remarkably well on these poor soils and the long staple variety known as Cambodia has yielded as much as 783 lbs. of *kapas* per acre. These results have at once borne fruit. Already over 1,000 acres of cotton (a crop hitherto unknown in this tract) are to be seen round Chandkhuri, and its cultivation has been extended to the areas of rice land when drained by means of trenches. That the zamindars already realize the possibilities of these soils, of which there are millions of acres in India lying waste, is shown by the fact that a few years ago they sold for Rs. 3 to Rs. 4 per acre while at the present time Rs. 75 an acre is being asked for this land at Chandkhuri. Irrigable *bhata* which used to be rented for four annas an acre has been leased this year for Rs. 10. Mr. Allan's aeration results on the heavy black soils at Nagpur are also of great significance. These soils improve rapidly when underdrained, and yield good crops of cotton and *juar* in wet years. The increased aeration following drainage leads to more rapid growth, to better root-development and to a marked improvement in the physical texture of the soil.

These examples, selected from many others, suffice to establish the fact that poor soil aeration is a limiting factor in crop production over very large

areas of the country and that its removal at once increases the yield. So far, the practical application of this physiological principle to Indian agriculture is only in its infancy, but its recognition has already opened up many new lines of work and old problems are being regarded from a new standpoint. There can be no doubt that Messrs. Clouston and Allan's aeration work in the Central Provinces indicates the manner in which the production of large areas of the Peninsula can rapidly be improved, while Mr. Main's work at Mirpurkhas, taken together with the Gungapur results in the Punjab, are certain to influence the irrigation policy of the future. At present, the duty of irrigation water in India is low. Not only does the revenue suffer but the water wasted does harm to the cultivator and to the country by lowering the natural fertility of areas which might easily be made one of the great bread-baskets of mankind.

Sugarcane.—At the cane-breeding station at Coimbatore in Madras, progress continues to be made by Dr. Barber in the production and study of new seedlings. No less than 77,000 new seedlings were raised during the past year of which about 5,000 were grown to maturity. Most of these, including the seedlings raised in former years, naturally proved useless but a considerable number have survived the process of elimination and are considered to be suitable for trial in Northern India. Briefly stated, the present position of these investigations is that a large amount of information relating to methods of work and to the most suitable parents has been obtained while sufficient material in the shape of new canes is available for trial at other stations. During the past year, 13 thick and 16 thin seedling canes were distributed to sixteen stations where the new forms will be tried against the varieties now in general cultivation. The results of these trials will be of great interest to the Indian sugarcane industry as a whole. Besides the work connected with new seedlings, Dr. Barber has devoted attention to other aspects of the sugarcane. A memoir on the classification of Indian canes has been published and papers have been prepared on tillering and on a method of comparing the growth of canes in different localities. Some work has also been done in connection with the formation of a sugar bureau for India which is said to be in contemplation.

Drugs.—One of the results of the war is a renewal of interest, after many years, in questions connected with an indigenous supply of drugs. At Cawnpore, Messrs. Leake and Annett have brought their investigations on the opium poppy to a successful issue. One of the new selected strains was tried on a field scale by the Opium Department in two villages in the Rai Bareli District where over 40 bighas were grown. Both in total yield and in morphine content the produce was distinctly superior to the local crop. The seed was purchased by the Opium Department and 108 maunds have been stored for issue next cold weather. Mr. Leake reports that "as the result of this

year's organization based on our proposals, the Opium Department have procured all the medicinal opium they require."

With regard to cinchona, Colonel Gage has completed a twelve months' tour through the hills of Southern India, Burma and Assam with the view of finding an area suitable for cinchona cultivation on a very much larger scale than hitherto. An area of about 400 square miles in the District of Tavoy between the Bay of Bengal and Siam has been recommended to the Government of India as the most suitable area for this undertaking.

Mr. Carter has commenced at the Indian Museum, Calcutta, a study of a number of species of importance in medicine and is undertaking investigations on some of these plants. Full details of this work are to be found in the *Report of the Botanical Survey of India* for 1917-18.

Rice.—Mr. Parnell has published the first of a series of memoirs on the inheritance of characters in rice, his conclusions being based largely on a study of the families obtained from naturally occurring heterozygotes. The chief characters investigated were the size of the outer glumes, the markings of the inner glumes, purple pigmentation of various organs and the black character of the inner glumes. At Dacca, Mr. Hector has resumed his studies on this crop. Mr. Clouston reports that a selected strain of Luchai rice, a variety obtained from a *zamindari* in the Raipur District 117 miles from the nearest railway station, gave larger yields last year on the Raipur farm than any of the other selected varieties.

Jute.—Messrs. Finlow and Milligan have obtained a relation between the length of the tap root and liability to chlorosis both at Dacca and also on the new alluvium. Plants with long straight tap roots are much more subject to chlorosis than those with short tap roots and a shallow spreading root system. It is hoped that this interesting case of the effect of soil aeration on the jute crop will be fully investigated.

Cotton.—The various problems connected with the growth and improvement of cotton in India were investigated during the cold weather of 1917-18 by a Committee which visited all the cotton growing tracts and examined a large number of witnesses. At the time of writing, the report of this Committee was expected to appear shortly. It will probably deal in detail with the botanical problems underlying the improvement of cotton in India and with the progress made up to the present time.

BOTANY.

II.—ECONOMIC BOTANY.

Part II.—Forest Botany.

BY

R. S. HOLE, F.C.H., F.L.S., F.E.S.,

Forest Botanist.

Soil-aeration.—Experiments were continued during the year with the object of determining the amount of oxygen and carbon dioxide contained in badly aerated soil and the effect of these gases on the development of the roots of *Sal* (*shorea robusta*) seedlings in water-cultures. It was found that if rain-water, with an initial content per litre of 5 milligrams carbon dioxide and 4·8 milligrams of oxygen, was held in corked pots (placed in the shade) in contact with soil taken from a local *Sal* forest, the carbon dioxide gradually increased to 100 milligrams in 9 days and 163 milligrams in 19 days, while the oxygen fell to 1·9 milligrams in 9 days and 1·2 milligrams in 19 days. At the close of this period, in 95 per cent. of the *Sal* seedlings growing in these pots the roots were completely dead and rotten.

Simultaneously with this pot experiment, *Sal* seedlings were grown in water cultures immediately adjoining the pots and carbon dioxide gas was bubbled through the culture solutions. After 20 days the roots of those seedlings in the gassed jars had become decidedly unhealthy but the concentration of carbon dioxide was then 500-600 milligrams per litre, *i. e.*, considerably higher than that which exists in the percolation water taken from pots in which *Sal* seedlings were suffering severely from the injurious factor. This fact, however, does not necessarily put CO_2 out of court as a possible cause of the damage. During these experiments it was noticed that those roots which happened to be near the exit of the gas tube were blackened and killed when those further away still remained uninjured and also that healthy roots were often produced near the upper surface of the solution which was in contact with the air and farthest removed from the gas tube mouth, while those deeper down were obviously unhealthy. It is believed that differences in concentration of this kind are even more marked in the soil than in water cultures such as those dealt with above. Moreover, there is reason to believe that the injurious action of CO_2 depends largely on the quantity of oxygen available and the oxygen supply in the soil in the pots mentioned above was considerably less than that in the culture solutions.

There is reason to believe that a deficiency of oxygen is in itself injurious to the roots while such a deficiency appears to be invariably correlated in the soil with an accumulation of CO_2 and possibly also of other poisonous substances. Analysis of the soil gases, therefore, promises to be of great practical importance in indicating the conditions of soil-aeration and in enabling us to change the treatment of our forests before serious damage has been done. A joint paper by the Imperial Economic Botanist and the Forest Botanist summarising recent work on soil-aeration was read at the Indian Science Congress at Lahore in January.

Experiments carried out during the year in the local Sal forests near Dehra Dun indicated that complete removal of the cover in narrow strips was more favourable to the growth of *Sal* seedlings than the removal of the undergrowth alone, with or without a thinning of the overhead cover.

Forest grasses.—The experiments to determine the most suitable method of working *ulla* grass (*Anthistiria gigantea*) for paper-pulp were continued in the Pilibhit Division of the United Provinces. This year's results support those of the previous year and indicate that annual cuttings of flowering and dead culms only, coupled with fire protection, is the best system to adopt, this producing a yield twice as great as that obtained by the other methods tested. Under this system it is believed that an average annual yield of dry culms of at least 1 ton per acre can be permanently secured. The gradual weakening of *ulla* grass frequently observed in fire-protected areas is believed to be due to the accumulation of dead leaves and culms which suppress and weaken the young shoots. Under a system of annual cropping, however, this material is removed and not allowed to accumulate, so that this danger is avoided. It is also probable that, in the dryer grasslands in this Division where *ulla* is absent, annual fires will considerably increase the available quantity of the valuable paper-pulp grass, *baib* (*Ischaemum angustifolium*), which would enhance the value of this locality as a site for a paper-pulp factory.

Oecology of Sal.—In the presidential address to the botanical section of the Indian Science Congress at Lahore in January, the Forest Botanist emphasized the economic importance of the parallelism between types of woodland and grassland and the correlation between such types and the conditions of soil and moisture.

An instructive example of this has recently come to notice in the Jaspur forests of the United Provinces. The regeneration of these forests has been an unsolved problem for many years, the forest is gradually becoming more open with a dense undergrowth of grass and unless seedling growth can be established to replace the existing trees these *Sal* forests must become extinct. The configuration of the ground is irregular, ridges and plateaus alternating with ravines and depressions. In the depressions the prevalence of the grass *Saccharum Narenga* indicates suitable soil and moisture conditions for *Sal* and

in such places the best young growth of *Sal* is actually found. On the slopes and ridges, however, the prevalence of *Saccharum spontaneum*, *S. Munja*, *Imperata*, *Eragrostis* and others indicates that here the soil is too dry for the satisfactory growth of *Sal* seedlings. These facts indicate that here we are dealing with a case of denudation. Previous to reservation these forests appear to have become open and the soil denuded and compacted under the influence of fires, unregulated fellings and grazing, to an extent beyond that which could be remedied by simple protection. Under existing conditions of simple protection, rain washes away the dead leaves and friable soil particles from the ridges and slopes into the depressions where a good moist soil is accumulating, while the ridges and slopes remain dry and hard. The obvious remedy, therefore, here appears to consist in increasing the soil moisture and improving the soil texture by inducing the rainfall to percolate into the soil and by preventing the dead leaves and humus from being washed away into the depressions. This can be done by breaking up the soil, supplemented where necessary by running shallow catch-water trenches along the contours. It is interesting to note that a similar parallelism between types of grassland and woodland has been recently recognized in the vegetation of the British Isles and it is believed that this phenomenon will be found to be of widespread occurrence and of considerable economic importance.

Spike Disease of Sandal.—The Forest Botanist visited Coorg during the year and studied this disease in the field. One of the most characteristic symptoms of the disease is the abnormal accumulation of carbohydrates (usually starch) in the diseased leaves and twigs. It is known that various factors may be responsible for an unusual accumulation of starch in the above ground parts of green plants, such as a deficiency of an essential nutrient substance, an acid soil, a deficiency of water, interference with the translocation of organic food and fungi. In nature, also, the disease appears to be usually associated with factors which either decrease the water supply or interfere with the translocation of organic food, such as damage to hosts, injury by fire and the attacks of fungi which kill the twigs and injure the cortex. As a result of these field observations, therefore, the suggestion has recently been made that the disease may be the final result of the *prolonged* action of such factors and experiments have been initiated with the object of testing this suggestion.

It is believed that, in the case of many fungi the direct damage done by which is insignificant and which are usually regarded as comparatively harmless and weak parasites, the possible effect of repeated and gradually extending damage on the nutritional processes of the plant as a whole and especially on the sap-circulation and movements of carbohydrates is frequently overlooked. In this connection it is interesting to note that W. B. Brierley has recently reported (*Kew Bulletin*, 1917, p. 315) a case in which the saprophyte or weak

parasite *Botrytis cinerea* has caused the rapid death of the greater part of a large woody plant owing to the fact that the tissues of the plant at some distance away from the actual hyphæ of the fungus, apparently stimulated by an enzyme excreted by the fungus, developed abnormally and produced an unusual number of tyloses which blocked the vessels and thus cut off the water supply from the leaves and branches. In the case of spike it is possible that the transport of the organic food in the cortex may be prevented in a somewhat similar manner.

Systematic.—Large numbers of specimens were collected by local forest officers, chiefly in connection with the preparation of local floras and descriptive lists in the United Provinces, Bihar, Bengal and Assam. Mr. Parker's Forest Flora of the Punjab was published during the year. Progress was also made with the preparation of the lists in the United Provinces, Bengal and Assam. During the year 94 specimens were identified by the Forest Botanist for the authors of Descriptive Lists and others and this work has brought to light species of the following genera which are probably new to science and will shortly be published : *Tamarix, Hopea, Eugenia, Ixora,* and *Mesua.*

The suitability of the wood of species of *Grewia* for œroplane construction was investigated during the year, in connection with which the systematic study of the genus now being carried on by the Forest Botanist proved to be of value. A preliminary paper differentiating *Grewia asiatica* Linn from *Grewia Kainesiana* was published during the year.

BOTANY.

II.—ECONOMIC BOTANY.

III.—Mycology.

BY

F. J. F. SHAW, D.Sc., A.R.C.S., F.L.S.,

Officiating Imperial Mycologist.

Agricultural Research Institute, Pusa.

The following is an account of the chief investigations at Pusa during the year.

Ufra of Rice.—The investigation of "ufra" a disease caused by an eelworm, *Tylenchus angustus* Butl. was continued by Dr. Butler in collaboration with the officers of the Bengal Agricultural Department. Evidence was obtained that this disease can be sometimes conveyed by seed from an infected crop.

The laboratory work at Pusa during the past season was directed chiefly to a study of the conditions which enable or induce the eelworm to leave the water of the paddy field and ascend the plant to reach its susceptible portion near the apex of the shoot. It was found that the worms can move freely when kept on glass slides at a relative humidity of 95 (temperature 87° to 90°F.) but not at 90, the exact point being apparently near 93. On the living plant they can move at lower air humidities, certainly below 90 but not at 75, at the same temperature.

Temperature also influences movement but less regularly. At low temperatures there is ordinarily little tendency to ascend shoots projecting out of the water even when the air is approximating to saturation.

Light is also a factor but starvation is one of greater importance. Well fed worms are much less active than those that have been starved for a long time.

Amongst the factors which control the wanderings of the worm in search of the food that it can only obtain from the living paddy plant, some, such as humidity, are absolute in that they impose conditions which rigidly limit the power to move while others are relative in that they act through the instinctive or other vital processes of the worm and so influence its movements indirectly and are more variable in their action.

As an indication of the practical application of such inquiries it is sufficient to mention that in certain districts the earliest attacks take place on the "aus" paddy growing in close proximity to or even mixed with the main crop, and that as the former ripens off about July it becomes unable to supply food to the worm; the latter must then rapidly fall into the starvation condition which will induce it to wander vigorously to the "aman" crop.

No new outbreak outside the previously known area was reported during the year except a small extension towards Chittagong.

In the Dacca and Faridpur districts successful demonstrations were carried out to show the good results obtained by treating paddy fields by burning the stubble before they were sown with "aman" or "digha" paddy alone or with "aus" and "aman" mixed or with "aus" followed by jute. A detailed account of the present state of knowledge of the disease has been written by Dr. Butler and it is hoped will be published during the coming year.

Black band disease of jute.—During the rains of 1917 a widespread attack of *Diplodia Corchori* Syd. on jute, *Corchorus capsularis*, was discovered in several parts of Bihar and Kamrup. This fungus was first collected as a parasite of jute in 1910 but until the present season it was not suspected of being more than an occasional parasite. The parasitism of the fungus has been proved by successful inoculations and is being investigated. The whole of the Bihar seed crop, which was intended for seed distribution, was collected in Pusa and disinfected by steeping in a 2 per cent. solution of copper sulphate for 10 minutes; the seed was carefully dried on a concrete threshing floor and it was then at once bagged and despatched to Dacca, a total of about 20 tons of seed was treated in this way. The jute seed crop in Kamrup was collected and treated at Dacca.

All field observations suggest that in some way the incidence of the disease is dependent upon the host plant reaching a certain stage of maturity and size and thickness of the stem. Dr. Shaw is investigating this disease and is also making further observations and experiments on *Rhizoctonia* on jute and its relation to this new black band disease.

Black thread disease of Rubber.—Mr. Dastur has continued the study of this disease. The remedial measures previously recommended have been tested on a plantation scale in Burma and have been found to be successful. The removal of seeds and the free admission of light and air by thinning and pruning have proved effective in reducing both the leaf fall and the black thread on the tapping surface but on account of the high cost of removing the seeds it is doubtful if this measure is commercially practicable.

The daily application of Izal on the tapping cut during the rains has not been found to be successful; though in the Federated Malay States it is reported to have given good results. The reason is that in Burma there is

more likelihood of the disinfectant being washed off in the frequent heavy showers of rain than in the Federated Malay States where the rainfall is not as high as in Burma and is distributed all over the year.

The extent of the damage done to the tapped bark by black thread seems to be directly proportional to the depth of the tapping cut. The deeper the system of tapping the greater is the percentage of the number of diseased trees and the more damage is done to the stem.

Fruit Diseases.—Dr. Shaw is investigating fruit diseases in Kumaun and Peshawar. Root rot of apple in Kumaun has been proved to be due to the attack of *Rosellinia*. It appears to be most severe in strongly acid soils, the analysis of which has shown a marked deficiency in lime.

The cracking of apple fruits, which is very common in Kumaun is due to the fungus *Coniothecium chomatosporum* Corda. A system of spraying against this disease is being tested during the current season.

In co-operation with Mr. Robertson Brown, Agricultural Officer, North-West Frontier Province, the spraying against peach leaf curl was continued. The advantages of this spraying have been conclusively proved.

Miscellaneous.—Experiments in the treatment of die-back of chillies caused by *Vermicularia Capsici* Syd. have been continued by Mr. Dastur. Spraying the crop soon after the flowers set and again a fortnight later has considerably checked the disease. Another measure found successful in completely controlling the disease is sowing the crop a month later than usual on highly manured land. A second serious disease of chillies causing blossom and twig rot was discovered last year. It is due to a fungus not previously known in India, *viz.*, *Choanephora cucurbitarum* (B. & Rav.) Thaxt.

Dr. Shaw has continued his work on the root rot of sal tree. The figures obtained during the past year in the fungus observation plots at Rajabhatkhawa show a number of new attacks but a relatively low proportion of fresh deaths.

A sclerotial fungus did considerable damage to Rangoon beans (*Phaseolus lunatus*) in Burma during the year under review. The fungus is in culture at Pusa.

A serious outbreak of disease on opium poppy was reported by the Agricultural Adviser, Central India States, and proved to be due to *Erysiphe polygoni*, a mildew not previously known as a parasite of poppy.

An undescribed species of *Cercospora*, other than *C. personata* (B. & C.) Ellis has been known to occur commonly on groundnuts for the past 10 years in various parts of India, but an outbreak at Ranchi last season was the first case in which it was observed as a serious disease. It is probable that the increased amount of the disease is due either to some deterioration in the plant or some unsuitability in the locality.

The year under review was marked by the passing of an order, under the Destructive Insects and Pests Act, regulating and restricting the importation of plants and seeds into British India. The provisions of the Act ensure that plants and seeds which are likely to introduce dangerous fungal diseases, not known in India, can only be imported if accompanied by a certificate from a competent authority in the country of export stating that they are free from certain fungal parasites.

Dr. Butler's book entitled "Fungi and Disease in Plants" was published during the year under review and supplies a long felt want in the literature of scientific agriculture in India.

Other Scientific Departments.

The following are the chief items of mycological work done by other scientific departments, chiefly Departments of Agriculture.

Madras.—The following note has been communicated by Mr. McRae, Government Mycologist :—

"The most important part of the work was that on *Phytophthora Meadii* n. sp. on *Hevea brasiliensis.* The flowers and rachis of the inflorescence were successfully inoculated with the fungus, so now it has been shown that all parts of the tree above ground may become attacked. A comparative study of *Phytophthora Faberi* Maub. on cacao and of this species on *Hevea* was made and cross inoculations were made with definite results, with the result that the two are considered to be different species. *Artocarpus integrifolia* (jack fruit tree) was suspected to be attacked by this fungus but it has not been actually found in the tree nor has the fungus been able to penetrate parts of young plants that were inoculated. Remedial measures were considered carefully in the field; some of the suggested measures were found impracticable and work has been reduced to protection of the tapped bark and to removal of dead wood and fruits. This is being done under observation in definite blocks and is being adopted to some extent generally on estates. A memoir on this subject is in the press.

"A bark disease was noted in one district but the cause was not found. The apparent absence of fungus hyphæ in much of the diseased tissue is noteworthy in this disease. The bark is dead, internally is yellowish and watery and becomes hard and brittle when dry. Extending laterally is a diseased tissue with yellowish or reddish brown streaks. It has no very characteristic outside features and is usually discovered by tapping into a layer that yields nolatex. That it is a serious disease is borne out by the fact that large areas, measurable in square feet, may be attacked in the lower part of the trunk within the tappable area.

"Blast of paddy similar to a serious disease in America, Italy and Japan has been observed in Tanjore district and the fungus *Piricutaria Oryzae* Br. & Cav. has been found on the diseased parts of the plants as has been found by investigators in those countries. Locally the disease did great damage; in some cases reducing the yield of grain to 37½ Madras measures per acre instead of an average of 720 Madras measures. It was found particularly on one variety (Korangu samba) and to a very slight extent on five other varieties. Later on the same disease was found to a smaller extent in North Arcot. The fungus has been brought into pure culture and is being studied.

"*Ustilago Crameri* Kornicke (smut) on *Setaria italica* (tenai) has been studied. It has been found that the spores on the seed are the most important so far as the infection of the plants is concerned. Ninety-five per cent. of the plants grown from infected seed produced smutted ear-heads. It has been found that 0·5 per cent. solution of copper sulphate completely stops germination of the spores of the smut and that the concentration does not affect the germination of the seeds of tenai adversely. Thus the same treatment may be recommended for tenai smut as we have worked out for the short smut on cholam, *Cintractia Sorghi-vulgaris* (Tul.) Clint. on *Andropogon Sorghum*."

Operations against the bud rot of palms in the Godavari delta and spraying against vine mildew in the Salem District were carried out in the year under review.

Mr. Anstead, Deputy Director of Agriculture, Planting Districts, reports that in co-operation with Mr. McRae, Mycologist to the Government of Madras, a certain amount of field work was carried out in connection with a few of the fungal diseases of special importance to the planting districts.

The brown blight of tea, caused by *Colletotrichum Camelliæ*, has been studied on the lines laid down in the last report and the recommendations have proved quite successful and practical in estate practice.

Mysore.—Dr. Coleman, Director of Agriculture, has continued work on spike disease of sandal.

Preliminary work on *Isaria* on mango hopper has been carried out. The work on the root disease of Areca Palms caused by *Fomes lucidus* and the stamping out of the Koleroga (*Phytophthora Arecae*) has been continued with success.

An account of the black rot of coffee caused by *Corticium Koleroga* (cke.) v. Hoeh. is ready for publication.

A comparative study of *Phytophthoras* has been started.

Bombay.—Mr. Ajrekar has continued the study of *Sphacelia* on jowar with a view to ascertaining its relation to *Cerebella*. A study of the life history of the *Ustilaginoidec virens* on rice has shown that affected grains produce healthy plants and that the disease cannot be produced by inoculating the flowers.

Messrs. Ajrekar and Kulkarni have continued their investigations of the rotting of stored potatoes and have found that *Rhizoctonia Solani* is chiefly responsible for storage rots under certain conditions, especially of high temperature.

Mr. Kulkarni's work on the smuts of jowar (Sorghum) in Bombay has been published. This officer is investigating the life history of a smut on *Eleusine coracana*, for the first time recorded in Bombay, and has undertaken spraying experiments against mildew on *Cuminum Cyminum*. The campaign against the Koleroga disease of areca palms has been continued. In Kanara sprayers have been purchased by the garden owners who do the spraying at their own cost.

Mr. Patwardhan has continued the operations against grape vine mildew which have been successfully extended to the Nagar district.

Indian Tea Association.—Mr. Tunstall has proved that the fungus which causes brown blight is identical with *Glomerella cingulata* and has also found *Nectria cinnabarina* as the cause of die back of stems of tea bushes in the Darjeeling district.

AGRICULTURAL BACTERIOLOGY

BY

C. M. HUTCHINSON, B.A.,

Imperial Agricultural Bacteriologist.

At Pusa work was done on the following subjects :—

Nitrification in Indian Soils.

Nitrogen fixation.—Symbiotic and asymbiotic.

Green Manuring.—Experiments in collaboration with the Imperial Agriculturist were continued.

Phosphate requirements of Soil bacteria.

Indigo.—Further work was done on the bacterial aspects of indigo fermentation in collaboration with the Indigo Research Chemist.

Pebrine.—Further research was made on the mechanism of infection and the methods of production of disease free seed.

In Bengal further work was done on the subject of Heart damage in jute by the Fibre Expert to the Government of Bengal.

No bacteriological investigations were carried out in any other Province or Administration.

FORESTRY.

I.—SILVICULTURE.

BY

EDWARD MARSDEN,

Silviculturist.

Statistical Work in typical forest crops.—Fifty-nine existing permanent sample plots were remeasured, and fifteen new ones were established. There are now 284 permanent sample plots. The new plots suggest that when made in a really suitable locality *Dalbergia Sissoo* plantations hold out very bright prospects. *Eugenia Jambolana* when grown pure and dense is found to yield a high volume increment at an early age. *Bombax malabaricum* in the United Provinces demands so much space that the annual growth per unit of area is considerably affected; moreover it seems possible that height growth is checked sooner than in a more favourable locality.

With greater knowledge of *data* from sample plots it becomes increasingly apparent that intensive tending will repay its cost almost invariably in good localities. Cleanings and thinnings in regular crops before the trees are 30 ft. high have been much neglected; unless trees have been trained from an early stage to take advantage of such artificial assistance they will not respond in the same degree to thinnings carried out in later life; and the more rapidly the tree grows naturally, the more evident is the effect of thinnings.

The Sal tree (Shorea robusta).—The remeasurement of 61 sample plots in the United Provinces has afforded *data* for estimating the rate of girth increment for this species when grown in regular crops in this locality. The results of the compilation are being published in the "Indian Forester."

The eight strips laid out last year in Thano forest with the object of inducing natural reproduction bring out clearly the trouble to be feared from weeds and the great advantages of a loose soil. A very large proportion of *Sal* seed fails to advance beyond the stage of mere germination owing to its being unable to establish contact with the mineral soil.

Tan-yielding Trees.—For producing the "shumac" yielding young leaves and twigs of *Anogeissus latifolia* the following conclusions have been reached: (*i*) Pollarding high is better than coppicing; (*ii*) The best season for pollarding is not later than March; (*iii*) Branchy trees are the most suitable; for producing numerous shoots girth is less important than branchiness; (*iv*) Trees of 5″ to 7″ diameter respond well to pollarding.

For *Cassia auriculata* it has been found that direct sowing on ploughed land in the open produces a dense crop: overhead cover is injurious: light, well-drained soil is desirable, protection from browsing is needed: weeding is desirable but not essential: irrigation is not needed: the seedlings are highly susceptible to root-rot in land charged with excessive moisture: frost is very injurious, killing 40 or 50 per cent.

Terminalia Arjuna.—Transplants from nursery during the first rains succeed; and this year direct sowings in loose soil, carried out before the rains start, have done well. The seedlings are sensitive to drip and to frost, against which weeding during the rains is a useful measure. Germination 45 per cent. If sowing is deferred till late June, watering is unnecessary; but to raise transplants in the nursery, sowing should be done in April-May, and watering is wanted. Plants sown direct appear to stand the hot weather better than transplants.

Afforestation.—Work done in Zabarkhet Tappar yielded the following deductions:

(*i*) Damage by deer and by pig is very severe; fencing is highly desirable and possibly essential; against pigs fencing is of little use, the best remedy is destruction. *Melia Azedarach* is attacked by deer less than most species.

(*ii*) *Dalbergia Sissoo* and *Melia Azedarach* appear promising species.

(*iii*) Nearly all species suffered from root-rot or damping off in the August-September heavy rains.

(*iv*) Cuttings from branches of various species nearly all sprouted but failed subsequently owing to the insufficient root development. Success was obtained with rooted cuttings.

Developments in Silvicultural Systems.—Throughout India the principle of concentrating attention upon a limited area for purposes of reproduction is becoming recognised. The tendency is away from selection by means of various transitional systems towards methods producing blocks of uniform, even aged forest. Only under such conditions is the most economic form of exploitation possible. Owing to the war some of the more recent working plans remain unprinted, and it is impossible to refer in detail to the modifications of the floating regeneration block system which have been adopted. For tropical forests the method of unit woods, limited in area but pure in constitution, is beginning to receive the appreciation it deserves.

For bamboos, continuous observations during eight years have yielded the following conclusions:—

1. Annual working, whether cutting high or cutting low, whether removing all old culms or only half of them, leads to more or less rapid reduction in size of clump, in number of new shoots, and in girth of culms.

2. When all the culms except those of the current year are cut, the clump deteriorates. This is true for 1-year, 2-year and 3-year rotations, and for cutting at a height of one node, three nodes, or five nodes. When the rotation is 4 years, this result is not so obvious.

3. When the rotation is one year and only half the number of old culms is cut, the results are better than when all old culms are cut. Height of cutting makes no difference. Of 15 clumps treated thus, only two were in good condition, and this method cannot be recommended. When only half the old culms were cut, the clumps under a 2-year rotation were in much better condition than those under a year rotation.

4. Whatever the rotation, some old culms should be left. Old culms are wanted both for the mechanical support of new shoots and to maintain the rhizomes in full vigour.

5. The effect of difference in height of cutting upon the health of the clump is either *nil* or so slight as to be negligible. Cutting high produces a number of twigs at the top of the stumps which impedes working.

Production of new shoots is not affected by height of cutting. But removing half the old culms gives more shoots than clear-felling all old culms, and 2-year rotation more than 1-year rotation. Of the methods under experiment, most new shoots were yielded by the clumps worked under a 2-year rotation when half the number of old culms were felled. Felling all the old culms fails to produce many new shoots even when the rotation is four years. But a 3-year rotation, some of the old culms being left standing, would probably give better results than a 2-year rotation.

Clear-felling all culms, including shoots of the current year nearly, but not quite, kills the clump. After four rains the clumps are beginning to look up again, and shoots ¾″ thick to arise. Repeating the complete cutting of all culms without exception for two consecutive years would here probably kill most clumps.

The published working-plans present no strikingly original features, the systems adopted being Coppice, Coppice with Standards, Improvement Fellings, Amelioration Fellings, Selection, Clear Felling and Uniform. The latter is applied by Mr. A. P. Davis to *Dipterocarpus* spp. in the Indaung forests of the Ruby Mines, but no principles are laid down on which the fellings should be conducted so as to produce conditions favouring regeneration. Experimental Research in this direction is much wanted in Burma as well as elsewhere.

FORESTRY.

II.—ECONOMIC FOREST PRODUCTS.

BY

R. S. PEARSON, I.F.S., F.L.S.,

Forest Economist.

Utilization of Assam Grasses for Pulp.—A note has already been prepared on this subject the publication of which is, however, not contemplated until it is possible to carry out further pulping tests. Such tests cannot be undertaken until a pulp plant is available for the workshops. Tests carried out up-to-date indicate that the elephant grasses of Assam may be expected to yield a 2nd class pulp.

Observation and encouragement of the bamboo pulp industry in India and Burma.—Accompanied by the representative of a Calcutta firm the writer inspected the Pegu Catchment Area in Burma, which was found eminently suited for the exploitation of bamboos for paper pulp.

Antiseptic treatment of Timber.—A detailed note has been published recording the results of all experiments carried out with various antiseptics and processes, both on a small laboratory scale and also confirmed by the condition of a large number of sleepers which have now been in the line in various localities for from 5 to 8 years.

The experimental plot at the Forest Research Institute, in which small stakes of 12 different species of timber treated with various antiseptics are embedded side by side with untreated specimens, has been maintained and extended by the addition of specimens treated with *Chir* Tar.

Sleepers in the line were inspected at Lakhsar, Lucknow, Ferozepore and Begamabad. The durability records show that treated sleepers both powellized and creosoted have every chance of proving satisfactory, as they have now been from various periods up to seven years in the line and are doing well. Such a statement receives confirmation from the fact that the North-Western and Assam Bengal Railways are now seriously contemplating the erection of plants for creosoting their sleepers.

A small open tank plant was also erected at the Mona Remount Depôt for the purpose of creosoting fencing posts.

Physical and mechanical properties and seasoning powers of various Timbers.—(i) *Natural Seasoning.*—The detailed enquiry commenced at the end of 1914 was completed during the year, and has given results of consider-

able value. The final inspections at the more important centres, such as Sukna in Bengal, Allapilli in S. Chanda and Dandeli in the N. D. Kanara, were carried out by the writer. The results show that the best method of dealing with *Adina cordifolia, Artocarpus Chaplasha, Cedrela Toona, Dillenia pentagyna, Diospyros Melanoxylon, Duabanga sonneratioides, Lagerstrœmia Flos-Reginae, Lagerstrœmia parviflora, Machilus odoratissima, Michelia Champaca, Morus indica, Schima Wallichii, Stephegyne parvifolia, Tectona grandis,* and *Terminalia belerica,* is to girdle the trees for periods varying from 12 to 36 months; that the timber of *Albizzia procera, Bassia latifolia, Pinus longifolia* and *Terminalia paniculala* and *Terminalia tomentosa* should be converted as soon after felling as possible; that green conversion followed by water seasoning for varying periods up to 4 months is most beneficial in the case of *Bassia longifolia, Bombax malabaricum, Grewia tiliæfolia. Lagerstrœmia microcarpa, Pterocarpus Marsupium* and *Xylia xylocarpa*; and that *Dalbergia Sissoo, Dalbergia latifolia* and *Albizzia Lebbek* should be seasoned in the log.

From experience gained from these experiments, it has been decided, after consulting all Chief Conservators and Conservators, to start at once a similar experiment on a more comprehensive scale, for the large number of second class timbers which were not included under the first experiments and the successful marketing of which will depend upon the determination of a correct method of seasoning.

(ii) *Determination of warp and contraction which takes place during seasoning certain timbers.*—A similar set of experiments to those carried out last year with *Pinus longifolia* to determine the amount of contraction which takes place while seasoning, have been started in connecton with *Teak.*

A series of shrinkage tests have been started in connection with the problem of finding suitable indigenous substitutes for European species employed in the manufacture of Aeroplanes. Thus it has been ascertained that *Shorea assamica* cut tangentially shrinks from 0·510" to 0·583", while when cut radially shrinkage only amounts to from 0·158" to 0·225" per foot across the grain. The variation in the case of *Poon* wood, *Calophyllum tomentosum* is equally marked, amounting to 0·630" to 0·744" when cut tangentially against 0·444" to 0·495" per foot across the grain when cut radially.

(iii) *Mechanical properties of timber* —

(*a*) A complete series of tests were carried out on Chanda Teak, at the request of the Divisional Forest Officer, which showed that this Indian grown Teak is in no way inferior to Burma Teak when subjected to Compression and Shearing strain, though slightly less strong when subjected to Transverse strain. As regards smoothness and general appearance for joinery it appears to be very much superior to Burma Teak, whereas on

the score of uniformity of grain and freedom from knots it bears no comparison with the latter.

(*b*) A series of tests dealing with no fewer than thirty species was started at the instance of the Munitions Board, to ascertain the strength of certain timbers as a basis for determining their suitability for special purposes. Results are as yet incomplete.

(*c*) A detailed enquiry is in hand with the object of determining the strength of plains and hill grown, seedling and coppice grown *Sal* from various localities; the completion of such an enquiry must necessarily take time, owing to the very large number of samples to be tested.

Finding of markets and new uses for timbers, including the issue of Bulletins.—Bulletins dealing with the uses, outturn and prices of *Duabanga sonneratioides* and *Acacia arabica* were published during the year, while similar information regarding (1) *Bombax malabaricum*, (2) *Adina cordifolia*, (3) *Lagerstrœmia Flos-Reginæ*, (4) *Dipterocarpus pilosus*, (5) *Hopea odorata* and (6) *Odina Wodier* is now being collected. Up-to-date 18 Bulletins of this nature have been published.

Close touch with the Munitions Board has been maintained during the year and information furnished on various subjects when called for.

Gums, resins and oleo-resins.—The enquiry regarding *Boswellia serrata* gum-oleo-resin was completed during the year, the results have been recorded and are now in the Press. From the report received from the Imperial Institute it appears that the turpentine can be succesfully utilised for varnish making, being graded for that purpose between French or Spanish and Swedish or Russian turpentines. The gum is being tested as a sizing material in a Bombay Cotton Mill and reports received up-to-date are most encouraging.

Woods suitable for—(1) *Paving Blocks.*

The *Teak* and *Xylia xylocarpa* paving blocks laid down in Frere Road, Bombay, were inspected during the year and have proved satisfactory, the result of this experiment being that the Bombay Municipality has now placed an order with the Southern Circle for the supply of 75,000 blocks.

(2) *Cotton and Jute Bobbins.*

Cotton bobbins were prepared at the Government School of Carpentry at Bareilly from the following species:—*Grewia tiliæfolia, Lagerstrœmia microcarpa, Adina cordifolia* and *Stephegyne parviflora.*

Though the results were most satisfactory as far as the bobbins themselves were concerned, it was found impossible to subject them to practical test on account of the impossibility of fitting them with metal reinforcements, no plant for this work being available. However, the samples have now been sent to a Bombay firm who are erecting a plant for this purpose.

(3) *Rifle Stocks.*—A visit was paid to the Ishapore Rifle Factory during the year. Carefully selected well seasoned pieces of *Terminalia bialata* were tested under the personal supervision of the Superintendent. This timber has been finally pronounced unsuitable owing to the development of fine cracks. Further selected and seasoned samples of *Albizzia Lebbek* and *Pterocarpus Marsupium* are now being sent for testing.

(4) *Timber suitable for Aeroplane construction.*—The Aeronautical Timber Expert has paid two visits to the Research Institute, during which matters were discussed, possible species selected for trial and the lines on which the mechanical tests should be carried out were determined. As a result it has been necessary to adapt the small machine in the Economic Workshops to these requirements and tests on a large number of species have been commenced. Of the possible substitutes for Spruce the following have been tested, *viz.*, *Calophyllum tomentosum* and *Shorea-assamica*, while of the possible Ash substitutes the tests for *Terminalia bialata* are now complete.

(5) *Ornamental Panelling.*—Selected samples of 19 species of timber were sent to the Convalescent British Soldiers' Voluntary Workshops, Mhow, under the direction of Mrs. Lukin, where they are being made up and polished by experts as panels. When completed they will form a special exhibit to demonstrate the qualities of indigenous timbers for this class of work.

Destructive distillation for charcoal and tar.—A number of experiments have been carried out on a small scale but the available plant is quite inadequate and the want of a suitable distillation plant has been much felt during the year.

(1) *Stockholm tar.*—As a result of the exhaustive experiments carried out by the United Provinces Forest Officers, the distillation of "Chilka" wood from *Pinus longifolia* for the production of Stockholm Tar has now been commenced on a commercial scale in the West Almora Division and shows promise of becoming a very profitable industry. The plant was visited during the year and attempts to find a market for the bye-products of distillation, a tarry oil and pyroligneous acid, have resulted in the examination and test of these products as a possible fly-deterrent for Surra-afflicted camels. Information has lately been received that the total outturn of these products will be taken by the Army Department.

(2) *Wood tar.*—At the suggestion of the Divisional Forest Officer, Jalpaiguri, a series of experiments were carried out with the object of determining the possibility of utilizing inferior broad leaved soft woods for the production of charcoal and tar. The species experimented upon were *Mallotus philippinensis*, *Kydia calycina* and *Odina Wodier* and also Ban Oak and Sal for purposes of comparison. A number of charges were distilled the results of which show that though an excellent grade of charcoal is obtained the yield of tar, average 1·5 per cent., is probably too low to make it commercially

profitable to utilize such species as a source of wood tar. The same conclusion as regards ordinary Chir waste wood has been arrived at by the Divisional Forest Officer, West Almora, *i. e.*, that it is not profitable to distil such wood for tar, only the highly resinous "Chilka" stump wood being utilizable for this purpose.

However, a small distillation plant for the production of charcoal and tar from *Babul* has been put up at the Mona Remount Depôt which is working satisfactorily, the tar being used for the ropes made at the Depôt.

(3) *Charcoal Briquettes.*—As a result of last year's experiments a number of enquiries have been received on this subject and a Calcutta firm apparently contemplates making a trial on a commercial scale. At present no proper briquette-making machinery is available, but the Forest Engineer, United Provinces, is now engaged in designing a suitable experimental machine, which it is proposed to work at the Forest Research Institute.

Experiments have lately been made in using tar as a possible binding material for such briquettes but with negative results.

ZOOLOGY.

I.—GENERAL ZOOLOGY AND PHYSICAL ANTHROPOLOGY.

BY

N. ANNANDALE, B. A., D.Sc., F.L.S., F.A.S.B.,

Director, Zoological Survey of India.

Research.—The research work of the department has been concerned to a large extent with the fauna of the "Chilka" Lake in Orissa, the Inlé Lake in the Southern Shan States and the various lakes in the Far East which I visited in 1915-16 while on study leave. Mr. Kemp, in addition to working on the crustacea of these lakes, has also published several short papers on the fauna of Indian estuaries; while Dr. Gravely has devoted his time mainly to preliminary studies of Indian spiders and to the completion of an account of the Passalid beetles in the collection. Dr. Chaudhuri has continued his ichthyological studies.

The preliminary investigations of the anthropology of the people of Calcutta have been continued.

Publications.—The following publications have been issued during the year:—

"Records of the Indian Museum" (Zoological Results of the Abor Expedition), Volume VIII, parts 10 and 11.

"Records of the Indian Museum," Volume XIII, parts 2 to 6.

"Records of the Indian Museum," Volume XIV (Fauna of the Inlé Lake), introduction, Aquatic Rhynchota and Aquatic Oligochæta.

"Records of the Indian Museum," Volume XV, Part I.

"Memoirs of the Indian Museum," Volume V, No. 6.

Papers, etc., on Indian Zoology.—The list of papers that have a direct reference to Indian Zoology has been prepared as usual by Dr. B. L. Chaudhuri. References to insects have, however, been omitted as it has been decided, in order to avoid duplication, that entomological literature shall be dealt with in its entirety in the report of the Imperial Entomologist.

ZOOLOGY.

II.—ECONOMIC ZOOLOGY.

Part I.—Agricultural Entomology.

BY

T. BAINBRIGGE FLETCHER, R.N., F.L.S., F.E.S., F.Z.S.,

Imperial Entomologist.

It should be noted that, in compliance with orders of Government that the Report on Agricultural Entomology in India during the year ended 30th June 1918 should not exceed four pages, exclusive of Bibliography, only a very brief summary of work done at Pusa and in the Provinces can be given this year.

I.—Work at Pusa.

Insect Pests.—Numerous observations have been made and a fuller account of these will be found in the Scientific Report of the Pusa Institute for this year. The following abstract shows the main crops and insects dealt with :—

Cotton.—Work on Cotton Bollworms (*Earias fabia, E. insulana* and *Platyedra gossypiella*) was continued. A quest for parasites of the last whilst boring in seeds was unsuccessful. The best trap-crop for bollworms was *Hibiscus Abelmoschus.*

Rice.—Stem-borers were investigated and a second species of *Chilo,* distinct from *C. simplex,* was differentiated. Examination of winter stubble showed that about 30 per cent. of stems had been attacked by borers of various kinds, that each acre of stubble contained at least 30,000 borer larvæ in December and that this number fell to about half by the end of March. Ploughing and exposure to sun of this winter stubble produce a largely increased mortality in the larvæ of *Schoenobius bipunctifer* present in the stubble. Some work on crabs as rice pests was also done.

Sugarcane.—Considerable attention was paid to borers in cane and wild species of *Saccharum,* with the result that ten species, all hitherto confused together as *Chilo simplex,* have now been discriminated ; for further details the reader is referred to the Annual Report of the Pusa Institute. Observations on the relative incidence of various pests in different varieties of cane have been continued with the apparent result that the cutting of borer-attacked canes is not efficacious.

Indigo.—The parasitization of Indigo Psylla (*Arytaina isitis*) was inquired into.

Mulberry.—Work done on "tukra" disease shows that this is due to the attack of a species of *Pseudococcus.*

Fruit Pests.—Work was continued on former lines.

Life-histories of Insects.—In addition to about 100 lots of borers in sugarcane and rice, about 200 lots of other insects were reared during the year and observations, and in many cases illustrations, made of their life-histories and habits. Five new pests were discovered in the course of this work, attacking cowpea, coconut, orange and *Sesbania*. The species referred to last year as *Cosmopteryx manipularis* has now been differentiated and described as *C. phaeogastra*.

Prain Storage Experiments.—These have been concluded. The method of storage under sand gave the best results. Further work was done on *Tribolium castaneum* and Bruchids in pulse-seeds.

Insecticides were tested as occasion arose.

rotection of Wood against Termites—These experiments were continued.

Lantana Work was continued in Southern India, Burma and Assam.

Bees, Silk and Lac.—The work was continued on previous lines.

Insect Survey.—Steady progress was made in addition to, and arrangement and identification of, the collections which included 6,471 named species of Indian Insects at the close of the year, as against 3,647 in 1910 and 2,221 in 1908. Twenty-two collections of insects were sent out during the year for identification by specialists.

II.—Work in the Provinces.

Madras.—The more important items of work done include (1) a study of the Cotton Stem Weevil (*Pempheres affinis*), (2) spraying against Mango Hoppers (*Idiocerus spp.*) in the Northern Circars, (3) a successful campaign against Tobacco Aphids in South Kanara, (4) demonstration and popularisation of control methods for *Spodoptera mauritia* on paddy in Malabar and for *Hispa armigera* in South Kanara.

Bombay.—Work was done at Poona on the life-histories of various weevils attacking *Canavalia ensiformis*, *Eugenia jambolana*, *Hibiscus esculentus* and *Cajanus indicus*, on Bruchids in leguminous seeds, on *Chaetodaccus zonatus* in mango fruits, and on fumigation of potatoes. At Ratnagiri the principal work was on pests of rice and coconut.

Central Provinces.—There were no serious insect-pests during the year except shoot-borers of sugarcane which especially damaged thick soft canes in Chanda.

United Provinces.—Further experiments on potato storage were done. The principal pest requiring study is *Platyedra gossypiella* in cotton seed.

Punjab.—Insect-pests of cotton were studied. Banding of trees with cotton-wool or with grease was found effective against *monophlebus*. Spraying against *Euphalerus citri* on Citrus trees was carried out at Sargodha. Mulberry silkworm eggs were distributed and reared in nine centres.

North-West Frontier Province.—Some work was done on apple pests, resulting in the discovery of *Gracillaria zachrysa* throughout North-West India and Assam.

Bihar and Orissa.—Special attention was paid to a Braconid parasite of *Agrotis ypsilon* with a view to its utilisation. The campaign against *Agrotis ypsilon* at Ghogha and Colgong, with 55 Andres Maire traps, was conducted with good results.

Bengal.—The principal items of work included control of *Diacrisia obliqua* on jute, of red spider on *ganja*, and the life-history of *Cryptorhynchus gravis*, a pest of mango fruits.

Assam.—Investigations were made of pests of orange and jack fruits. Trials of an Andres Maire trap for control of *Cirphis unipuncta* proved successful.

Burma.—Various investigations were made, principally on pests of rice, cotton and stored products.

III.—Native States.

Baroda.—The Entomological Assistant worked on Tobacco Stem-borer (*Phthorimaea heliopa*) which breeds continuously in the tillerings until the removal of stumps from the fields. Hairy caterpillars (probably *Amsacta moorei sara*) only appeared in very small numbers in 1917.

Mysore.—*Amsacta albistriga* was controlled by handpicking of the moths. Experiments with a wash against *Xylotrechus quadripes* were conducted on a large scale with promising results. Four species of sugarcane borer were under observation. *Achaea janata* was controlled by picking of the first brood of caterpillars.

Travancore.—(No report has been received).

Kashmir.
Hyderabad. } No scientific work was done.

IV.—Other Entomological Work.

Indian Tea Association.—The work on Tea Mosquito (*Helopeltis theivora*) was continued and experiments showed that, in cases where it was supposed that potash manures were largely fixed when added to the soil, the addition of large enough quantities to allow of this fixation and yet leave a sufficient quantity free to alter the soil ratios considerably effectually prevented an increase in the damage done by the pest. The observations on Green Manure pests were continued.

South Indian Planting Districts.—The following pests have been noted during the year, *viz.*:—On tea, *Thosea cervina*, *Heterusia virescens* and *Zeuzera coffeae*; on coffee, *Ochrophara montana*; on fruit, *Chelidonium cinctum* and *Sathrophyllia sp.*; and on vegetables in the Shevaroys, *Euxoa segetis*.

ZOOLOGY.

II.—ECONOMIC ZOOLOGY.

Part II.—Forest Entomology.

BY

C. F. C. BEESON, M.A., I.F.S.,

Forest Zoologist.

Insects of the Sal.—(*a*) *Hoplocerambyx spinicornis.*—The Forest Zoologist visited the scene of the local outbreak of this borer in Thano forest, Siwaliks Division, United Provinces, and carried out sample plot surveys and a complete enumeration of the infested area. Ten thousand trees have been attacked by the borer in addition to the 7,000 marked in the previous year. The development of the epidemic is very irregular ; in some compartments the rate of increase is from 1½ to 20 times that of last year, in others the incidence is reduced to less than one-half. There is an indication that after a certain proportion of the growing stock has been killed off, migration occurs, with the result that the highest intensity of attack is shifting to the younger periodic blocks.

Control measures were devised but scarcity of labour prevented their adoption.

Experiments were initiated in the insectary to determine the effect of extremes of temperature and rainfall on (1) the pupal period, (2) emergence of beetles and (3) oviposition.

(*b*) *Aeolesthes holosericea, Dialeges pauper, Diorthus simplex,* etc. and (*c*) shot-hole borers. The distribution, host trees, and life cycles of the borer fauna of sal have been under investigation throughout the year. The insectary records from material received from all sal divisions form a mass of important data now in process of interpretation.

A tour was made in Gorakhpur and Gonda Divisions, United Provinces, to study insect-pest conditions in sal coppice and uniform high forest. A note has been prepared for publication, explaining the absence of *Hoplocerambyx spinicornis* in plains forests of this type.

The mixed forests on the south slope of the Siwaliks were visited to obtain records of other hosts of sal borers.

(*f*) Pests of seedlings, cockchafer grubs, and grasshoppers, were investigated in G ? akhpur and Gonda Divisions.

Insects of the Teak.—(*a*) *Duomitus ceramicus.*—In May and June 1918 the Forest Zoologist visited teak plantations in the foot hills of the Pegu Yomas and re-examined borer observation areas established by special officers in 1916. The early larval stages were studied under field conditions and fluctuations in the annual incidence determined for 5 localities; stem analyses were made of plantation trees in Tharrawaddy, North and South Toungoo and Pyinmana Divisions, and a method was devised for determining the age of beeholes. The following general conditions were drawn :—

1. The beehole borer (in the Pegu Yomas) has increased in abundance, appreciably during the last two decades. The borer appears at an earlier stage and its incidence rises more rapidly in plantations made since 1900 than in plantations of the seventies and eighties.

2. The number of beeholes in trees over 10 inches girth is proportional to the girth of the tree, and is independent of its classification as a suppressed, dominated or dominant tree. From curves of increase constructed on the ratio of the girth b. h. to the number of beeholes, it is estimated that each tree in the final crop of an average plantation will contain a sufficient number of beeholes to render it useless for timber.

3. The effect of a dense undergrowth, especially of bamboos, is considered to be measureable. There are indications that it delays the appearance of the borer and reduces the incidence, but in no way approximate to the requisite degree. Encroachment or infiltration of tree species other than teak together with bamboos has a protective effect, but this is apparently due to the reduction or isolation of the teak.

(*b*) *Haplohammus cervinus.*—No field work has been possible with this species. Its distribution is now known to include Lower Burma (records from Mansi, North and South Toungoo and Pyinmana).

(*c*) *Hybolea puera* and *Pyrausta machoeralis.*—A field party was sent to Nilambur Division, Madras, in November—January under the direction of the Assistant to the Forest Zoologist. The two pests specially mentioned were found to be temporarily replaced by other species, mainly Noctuidae, which exhibit the same type of defoliation hitherto believed to be characteristic of the more notorious species. Their life-histories were carried through in a field insectary and observations were made on a ubiquitous wilt disease which may prove of economic importance.

The evidence available from Nilambur and Lower Burma indicates that the defoliation of teak is produced by a faunal complex of Noctuids, Pyralids, Arctiids, Curculionids, Melolonthids and Rutelids, varying in relative abundance from year to year.

Insects of the Chir.—No field work was carried out with this group. The Divisional Forest Officer, Garhwal, recorded cases of apparently primary attacks of *Platypus biformis*, Chap and *Cryptorhynchus brandisi* Steb.

Insects of the Toon.—The publication of the bulletin on the life-history of the toon shoot and fruit borer has been delayed owing to the non-receipt of identifications of its parasites.

Miscellaneous pests.—During the year 102 separate consignments of specimens were received from Divisional Officers and others (as against 65 last year); of these only 34 were sent at the request of the Zoologist.

A large number of new pests, and new food plants of known pests, was recorded from material sent by Divisional Officers, etc., and from observations made by the Forest Zoologist on tour. The records are too numerous to include in this report; the most important are new defoliators of teak, sal and ban oak; new borers of teak, sal, *Acacia Catechu*, *Albizzia procera Butea frondosa*, *Dipterocarpus turbinatus*, *Lagerstroemia parviflora*, *Pterocarpus Marsupium*, *Shorea obtusa*, *Terminalia belerica*, *Terminalia bialata*, *Terminalia tomentosa* (timber exported for military purposes), and new pests of trees cultivated in nurseries, *e. g.*, *Bucklandia populnea*, *Dalbergia sissoo*, *Ficus elastica*, *Phoebe attenuata*, *Quercus lamellosa*, *Shorea robusta*.

An annotated list of forest insects with their food plants and distribution is in course of preparation.

A paper contrasting forest insect conditions in British India with those in other parts of the world where systematic forestry is practised, was read at the Science Congress in Lahore in February.

Insect Collections.—Owing to the heavy losses of material in submarined ships last year, no collections were sent to Europe for identification with the exception of a batch of longicorn beetles to Dr. C. J. Gahan and some coccids to Mr. E. E. Green. A small collection of identified Trypetidæ was received from Professor Bezzi of Torino and a collection of Tachnidæ was identified by Mr. J. D. Tothill of Ottawa; a paper describing 8 new species in the latter collection was published in the Bulletin of Entomological Research (IX, 1918, pp. 47—60). Specimens of flies, moths and beetles were sent to the Director, Zoological Survey of India, and to the Imperial Entomologist for determination.

In the reference collection several families have been thoroughly revised and numerous additions made in all groups. In the Insectary over 150 breeding cages are in constant operation; these yield an average of 80 insects a day, mostly borers, which are gradually being identified and added to the collection.

Museum.—Additions comprise a series of examples of (*a*) the work of borers of sal, and teak and their associates, (*b*) defoliation of teak; a set of distribution maps of the more important forest insects; and the following donations:—fœtal tigers, skins of Himalayan racoon (used as a hat by Mishmis), silver jungle cock, ground thrush and other birds, bird's eggs, skins of pangolin, and various snakes and lizards.

VETERINARY SCIENCE.

BY

A. LESLIE SHEATHER, B.Sc., M.R.C.V.S.,

Director and First Bacteriologist, Muktesar.

The shortness of staff together with the deputation of the Second Bacteriologist (14th June to 8th October 1917) for special duty in Mesopotamia and increase in routine and administrative duties have again limited the time that could be given to research work.

As in the past year, minor investigations connected with the examinations of specimens and serum tests for the diagnosis of Dourine were carried out.

Rinderpest.—The question of the vitality of the virus of rinderpest under varying conditions is still under investigation and a special series of experiments is being carried out with the object of ascertaining the length of time for which hides removed from animals dead of rinderpest remain infective.

Anthrax and Hæmorrhagic Septicæmia.—The modifications in the manufacture of these sera foreshadowed in last year's report have been effected and have resulted in a very distinct reduction in the mortality among the serum-making animals, and also in a saving of labour.

The question as to the length of time hides from animals dead of Hæmorrhagic Septicæmia remain infective is also under investigation.

Dourine.—The applicability of the complement fixation test to the diagnosis of trypanosome infections in India has been demonstrated and a large number of samples of serum have been examined.

Experiments have been directed to simplifying the technique of the test and overcoming difficulties in the preparation of the reagents and collection of the samples of serum.

Contagious abortion in cattle.—A number of attempts were made to isolate the organism responsible for this disease from pathological materials sent to the Laboratory, but all failed owing to the presence of numerous contaminating organisms. A culture of the bacillus responsible for the disease in Europe was obtained through the courtesy of Sir John McFadyean of the Royal Veterinary College. This strain is now kept running in the Laboratory.

Up to the present the number of tests carried out is too small to warrant any definite opinion, but the results of the tests appear to indicate that the same bacillus is responsible for the disease in India.

Johne's disease.—The animal referred to in last year's report as suspected of being infected with this disease succumbed to traumatic peritonitis.

Post-mortem examination confirmed the diagnosis. Attempts to cultivate the bacillus of Johne's disease and to infect animals by contact have so far failed.

Pleuro-pneumonia of goats.—Provision of susceptible animals for experimental work in connection with this disease was made and a quantity of material from a natural case of the disease was received. Unfortunately pneumonia of a different type broke out among the animals selected for experiment and it was found impossible to use the material available with any hope of getting reliable results.

When the outbreak of pneumonia was over efforts to obtain further infective material were unsuccessful.

Tuberculosis.—Investigation in connection with this disease of necessity make slow progress as the bacillus grows very slowly in artificial culture and in animal inoculations periods of weeks or months have to elapse before experiments come to maturity.

A number of strains of tubercle bacilli have been isolated from bovine lesions and these are being studied.

Reports from Veterinary Colleges and Provincial Laboratories.—(*i*) Mr. Taylor, the Superintendent, Civil Veterinary Department, South Punjab, has written a "Note on the Prevalence of Bovine Tuberculosis in the Punjab".

(*ii*) Mr. Wilson, the Superintendent, Civil Veterinary Department, Central Provinces and Berar, enumerates the following investigations worthy of record :—

(*a*) The prevalence of Foot-rot in sheep in these Provinces has been authenticated and recorded for the first time, in all probability, in India.

(*b*) A case of filaria in the peripheral blood of a calf belonging to the Central Provinces Vaccine Institute which on morphological grounds appeared similar to a species of blood micro-filaria found in man.

(*c*) Spirochætosis has been noted in various tissues of bovines and equines. In bird-spirochætosis soamin treatment was again effective in several outbreaks.

(*d*) Mortality has again been recorded in bovines due to trypanosomes which may possibly be a new variety of these parasites as they appear to be midway in size between *T. evansi* and *T. theilleri*.

(*e*) Sarcosporidiosis has been noticed in sheep and bovines. It is probable that some animals have died from the effects of invasion.

(*f*) Some attention is being devoted to the study of entomology and several species of blood-sucking flies have been identified and recorded.

MEDICAL RESEARCH.

BY

THE HON'BLE MAJOR-GENERAL, W. R. EDWARDS, C.B., C.M.G., K.H.P., M.D., I.M.S.

Director-General, Indian Medical Service.

The following account is extracted from the Report of the Scientific Advisory Board of the Indian Research Fund Association for 1917-18.

Plague.—The inquiry into plague preventive measures that has been carried out in Poona by Dr. Chitre continues. Major J. C. G. Kunhardt who started the investigation has recently been able to keep in close touch with the inquiry although he has reverted to Military employ. Very considerable progress has been made and the Board recommend the continuation of the inquiry for another year. The report that has been received is a valuable addition to our knowledge of rat poisons and the habits of rats which should lead to greatly improved method of rat destruction. Endeavours are at present being made to evolve a more satisfactory type of rat-trap than those at present in use.

Hook-worm disease.—Since our last annual meeting Colonel Clayton Lane has submitted a valuable final report on the investigations carried out in the Darjeeling District. He has shown that two-thirds of the labour forces in that district are infected with hook-worm and that though most of the infections are light the treatment of those infected has been followed by a marked improvement in health with a consequent increase of efficiency. He has demonstrated that no infection, however light, can be disregarded as entirely harmless to the host and that all infections are of sanitary importance.

Dr. Mhaskar continues a similar inquiry in the town of Dindigul and in its neighbourhood and amongst the prisoners in the Trichinopoly Jail. Infection with hook-worm is all but universal in this part of India; experience in the jail shows that even light infections render the host more liable to other disease especially those of an intestinal type. A report by Dr. Mhaskar on the results hitherto achieved is at present under the consideration of the Board.

Several of the local administrations have started hook-worm investigations in the jails of their respective provinces in aid of which the Indian Research Fund Association have given financial grants.

Entomology.—Mr. Awati continues his investigations into the genus Musca. Two reports dealing with this subject have been published in our journal during the year. Mr. Swaminath is assisting Mr. Awati in his inquiry.

Mr. Mitter is engaged in a study of sandflies in Lahore where the Veterinary College has kindly given him laboratory accommodation.

Diabetes.—Major D. McCay continued his investigation of diabetes in Calcutta. Sanction to the continuance of the inquiry up till the 30th of June has been accorded. Major McCay is at present engaged in writing a report on the results hitherto attained.

Leprosy.—Dr. Sudhhamoy Ghosh continues his work under the general supervision of Sir Leonard Rogers in Calcutta. Reports that have been published in our journal indicate a definite advance in the treatment of leprosy.

Investigations in Karachi.—Major Greig continues to do most valuable work in military hospitals of Karachi. The Indian Research Fund Association have given assistance in the matter of staff and equipment.

Beri Beri.—Sanction was accorded in January last to a investigation of the subject of beri beri to be carried out by Lieutenant-Colonel McCarrison. Coonoor has been made the head-quarters of the investigation where the Pasteur Institute Association of Southern India have kindly placed laboratory accommodation at the disposal of Colonel McCarrison.

Bio-chemistry.—Mrs. D. Norris has recently started an inquiry at the Central Research Institute, Kasauli, where she is studying the relationships existing between the yield of culture media and their chemical composition and mode of preparation. The problems involved are of extreme practical importance at the present time in connection with large demands of vaccine for troops overseas.

Tuberculosis.—The opinions of the local Governments on Dr. Lankester's Report on the prevalence and prevention of tuberculosis in India are still under the consideration of the Scientific Advisory Board. In the present abnormal conditions the Board have no recommendation to make. The Governing Body will be addressed later on this important matter.

Hydrocyanic Acid Gas as a Disinfectant.—The work carried out by Lieutenant-Colonel Glen Liston in this connexion has attracted considerable attention and he has received numerous requests from Railway and Shipping Companies for assistance in applying this form of fumigation to railway carriages and trucks and ships. Further modification in apparatus have to be effected before the method can be applied to ships. To assist Lieutenant-Colonel Liston in this matter the Board recommend the grant of Rs. 5,000.

Miscellaneous.—A grant of Rs. 5,000 was made to Dr. Mackenzie Wallis to aid him in his investigations into the food value of ground-nut flour. He has recently submitted a second report which it is proposed to publish in an early number of our journal.

A grant of Rs. 1,000 was made to Major McAdam in aid of the inquiries which he was carrying out in the military laboratory on the subject of dysentery. A report from his pen dealing with the amœbic dysentery carrier has already been published.

APPENDIX.

Report on the principal work conducted for India at the Imperial Institute during the year ended 30th June 1918.

BY

W. R. DUNSTAN, M.A., L.L.D., F.R.S.,
Director, Imperial Institute.

Scientific and Technical Research Department.

I.—SCIENTIFIC INVESTIGATIONS.

Owing to depletion of staff and the pressure of urgent work in connection with the war it was not possible to make much progress during the year with the research on Indian aconites, or to undertake other scientific investigations of Indian products. Such work will be resumed at the earliest opportunity.

II.—TECHNICAL AND COMMERCIAL INVESTIGATIONS.

A.—Experimental work.

Fibres.

Cotton.—Five samples of unginned cotton grown at the Experimental Farm at Sindewahi were forwarded by the Director of Agriculture, Central Provinces. The samples, which represented the following varieties; Buri selected, Sindewahi Cross, Cambodia, Rosea, and Bani X Rosea 1145, were found to be of better quality on the whole than similar samples from the Farm received at the Imperial Institute in 1916. They were valued at prices ranging from 15·75*d.* to 18·75*d.* per lb. with "middling" American cotton at 18·77*d.* per lb.—(September 1917).

Kapok and Akund Floss.—A series of tests has been carried out at the Imperial Institute for the purpose of comparing the relative buoyancy of Indian kapok (*Bombax* sp.) and Akund floss (*Calotropis* sp.) with that of Java kapok (*Eriodendron anfractuosum*) in order to determine whether these Indian flosses could be recommended for use in life-saving appliances in place of Java kapok. The samples of Indian flosses used in these tests were supplied by the Director-General of Commercial Intelligence in Calcutta.

The experiments showed that the machine-cleaned Indian kapok is superior in buoyancy to genuine Java kapok of good quality and fully satisfies the requirements of the Board of Trade regulations relating to kapok for use in life-jackets, etc. The results were communicated to the Board of Trade with the suggestion that Indian kapok of good quality might be recognised for this purpose as well as Java kapok. The Board stated however, that they are not prepared at present to give this permission on the grounds that Indian kapok

is liable to be adulterated with Akund floss, that no commercial standard for Indian kapok has been established, and that no guarantee could be given that commercial supplies used by manufacturers would be equal in quality to the sample tested at the Imperial Institute. If, however, it is established that properly cleaned Indian kapok is obtainable on a commercial scale the Board have agreed to an official test being made. Enquiries are now being made in India as to whether regular supplies of machine-cleaned kapok, similar to the consignment forwarded to the Imperial Institute, will be available.

Akund floss is distinctly inferior to kapok in buoyancy and is unsuitable for use in life-saving appliances, as it will not stand rough usage and rapidly becomes water-logged.

Patwa and Dhencha fibres.—Sample of these fibres were forwarded to the Imperial Institute by the Assistant Director of Agriculture, Eastern Circle, United Provinces. One of the samples of Patwa fibre, labelled "Patwa of Pusa" was similar to Bimlipatam jute, and was valued nominally at £40 to £42 per ton in London with first marks Calcutta jute at £45 per ton under Government control (February 1918).

A sample of "Patwa desi" fibre was of better quality than the preceding specimen, and compared favourably with the superior grades of Bengal jute; its nominal value was £45 to £48 per ton in London (February 1918).

The Dhencha fibre was similar to Coconada hemp and would be suitable for mixing with Indian hemps, but its brittleness might cause difficulty if the fibre were worked alone. The fibre was valued at £65 per ton in London (February 1918). Its pre-war value would have been about £20 per ton in London.

Oilseeds, Oils and Waxes.

Soy Beans.—A sample of brown soy beans grown in the Chin Hills, Upper Burma, was forwarded by the Deputy Director of Agriculture, Mandalay, for analysis and valuation. The beans were in good condition and of normal composition, containing 15·9 per cent of oil, equivalent to a yield of 17·4 per cent. from the dry beans. Under normal market conditions these soy beans would find a ready market in the United Kingdom, and it was suggested that experiments might be carried out in Upper Burma with some of the varieties of soy beans producing light-coloured seeds, which usually realise a slightly higher price than the dark-coloured varieties.

"Porpoise" Oils.—Samples of oils stated to be derived from the body and jaw of the Gangetic porpoise were forwarded from Assam for examination in connection with a suggestion that porpoise oil manufacture might be undertaken in Assam. The samples did not agree in composition with the figures recorded for porpoise oils, and it appeared probable that the oils were derived not from a porpoise but from the Gangetic dolphin (*Platanista gangetica*).

From the results of the examination of the oils at the Imperial Institute it did not seem likely that the "jaw" oil would be suitable for use in place of true porpoise jaw oil for lubricating delicate machinery. Both the "jaw" and "body" oils might however be employed as substitutes for fish or whale oils in the manufacture of soap or in leather dressing, etc. It was recommended that if the oils are obtainable in commercial quantities it would be desirable to forward larger samples to the Imperial Institute for further examination and valuation.

Beeswax from India.—In 1915 the Imperial Institute called the attention of the Government of India to the fact that the extensive adulteration to which Indian beeswax is liable was a serious handicap to extension of the use of the wax for certain purposes. The communication from the Imperial Institute was published by the Government of India in order to draw attention to the subject, and considerable correspondence with firms both in this country and in India has resulted. Subsequently the Director-General of Commercial Intelligence at Calcutta forwarded to the Imperial Institute several samples of Indian beeswax some of which were described as pure and others as adulterated. These samples have been submitted to a careful chemical examination at the Imperial Institute and the figures obtained compared with those previously recorded for Indian beeswax. The results of the investigation show that there is still considerable uncertainty as to the precise composition of unadulterated Indian beeswax, which makes it difficult to decide in some cases whether a sample is pure or adulterated. It would be of considerable commercial importance to establish definitely the constants of genuine Indian beeswax, and the Imperial Institute has therefore suggested to the Indian authorities that authentic samples of beeswax should be specially collected under supervision from the different districts in India and forwarded to the Imperial Institute for examination. On arrival these samples will be examined at the Imperial Institute in order that the constants of the genuine wax may be placed on record for the future guidance of merchants, manufacturers, public analysts and others concerned with the trade in Indian beeswax.

Essential Oils.

Boswellia Turpentine Oil.—A sample of turpentine oil prepared from the oleo-resin of *Boswellia serrata* was forwarded by the Forest Economist at Dehra Dun for examination in continuation of a previous investigation.

The results of examination indicated that the oil differed from the preceding specimen in containing a much larger percentage of the high-boiling constituents, but that nevertheless varnish prepared with it dries rather more quickly than that made with ordinary commercial turpentine oil.

There seems to be little doubt that this Boswellia turpentine oil could be successfully utilised for varnish making in place of ordinary turpentine oil, but it is not possible to determine its exact commercial value until the product has been tried on a considerable scale.

Drugs.

Opium.—In continuation of the investigation of Indian opium previously carried out at the Imperial Institute, eight samples of opium from different districts of the United Provinces were received for further examination. The samples had already been submitted to partial analysis in India and consequently twenty-four representative samples were selected from the series and submitted to detailed examination at the Imperial Institute. All these samples were found to be of good quality, containing from 9·5 to 14·2 per cent. of morphine, with an average of 11·6 per cent.; and from 1·8 to 4·0 per cent. of codeine with an average of 3·3 per cent. Opium of this quality would be quite suitable for the manufacture of alkaloids, and also for medicinal purposes in the United Kingdom, after dilution, if necessary, in order to reduce the percentage of morphine to the 10 per cent. standard of the British Pharmacopæia.

Fifteen samples representing bulk supplies of crude opium available at the Ghazipur Factory were also forwarded by the Superintendent of the Factory for examination. Twelve of these samples consisted of Benares crude opium taken from separate vats at the factory and were found to be of very good quality, containing an average of 10·48 per cent. of morphine and 3·89 per cent. of codeine. The three other samples consisted of Malwa opium and were of lower quality, containing from 8·38 to 9·45 of morphine.

These results confirm those previously obtained at the Imperial Institute, and there can be no doubt that much of the opium produced in the United Provinces contains high percentages of morphine and codeine and is quite suitable for manufacturing purposes or medicinal use in the United Kingdom.

Belladonna.—A sample of belladonna leaves from the United Provinces was found to contain a high percentage of total alkaloid, but owing to defective preparation the material was not likely to be readily marketable in the United Kingdom. Consignments of well-prepared leaves of similar character would however be saleable at good prices in London, and recommendations were made by the Imperial Institute as to the methods of preparation which should be adopted.

A sample of belladonna stems contained very little alkaloid and would be of no commercial value.

Foodstuffs.

Beans.—The following samples of beans from Burma were forwarded by the Director of Agriculture, Northern Circle, Burma, for examination at the Imperial Institute in continuation of previous investigations.

(a) Bo-sa-pe-apyu beans grown experimentally on the Mandalay Farm, Burma, were found to have a high food value, being rich in protein and similar in composition to haricot, and Madagascar beans. These beans contained no cyanogenetic glucosides. Their nominal value, under Government control, was estimated at £36 to £37 per ton c.i.f. London (March 1918).

(b) Samples of Pe-nge beans representing the second and third years' crops at Natywagon, and the first and second years' crops at the Mandalay Farm, were examined in order to determine the amounts of prussic acid which they yielded. The percentages were found to be satisfactorily low in all the samples. The beans were of good colour and appearance and would be readily saleable in large quantities at the controlled price of £42 per ton c.i.f. London (March 1918).

(c) Samples of Pe-byu-glay beans gave yields of prussic acid which were undesirably high but would not in view of past experience be considered dangerous to cattle.

Rice.—In connection with the work now being done by the Department of Agriculture in Burma on the improvement of rice, a series of twelve selected varieties of rice was forwarded to the Imperial Institute in order that their suitability for use by British rice millers might be determined. A detailed chemical examination of the twelve varieties was made at the Imperial Institute in order to determine their relative composition, and samples were then submitted to rice merchants and brokers for their opinions. A full report giving the results of the commercial enquiries made by the Imperial Institute was furnished to the Agricultural Department in Burma. Samples were also submitted to starch manufacturers and brewers in order to determine the suitability of the different rices for these purposes. The results of this work show that any of these twelve varieties of rice could be used for brewing or starch manufacture. It would, however, not be worth while to select varieties of rice for cultivation with the special object of meeting the requirements of these industries, in which broken rice is principally employed.

B.—The Technical Information Bureau.

During the year information relating to Indian products was supplied to Government Departments both in India and at home and to manufacturers, merchants and others in this country and other parts of the Empire. The greater part of the enquiries were concerned with Indian raw materials and their commercial utilisation and with the technical requirements of certain manufacturing industries. The subjects of these enquiries included the following :—

Minerals.—Preparation of asbestos for the market, bauxite and alumina, cement-making materials, coal and coal distillation, chrome ore, corundum, the iron and steel industry in India, limestone, magnesite, manganese ore for

electrical batteries, mica, monazite, platinum, potash, rubies, the Indian salt industry, shale, strontium minerals, sulphur and pyrites, tungsten ores, zinc ores.

Oilseeds and Oils.—Candle nuts (*Aleurites triloba*), castor oil seeds; chaulmoogra oil; copra; preparation of desiccated coconut; cotton seed and cotton seed oil; ground nuts and ground nut oil; linseed and linseed oil; margosa oil; cultivation of mustard seeds; *Schleichera trijuga* seed, and the oil and cake derived from it; soy beans; tea seed oil; the preparation of edible vegetable oils as ghi substitutes.

Timbers.—Indian timbers suitable for making three-ply wood for tea chests, timbers for bobbin making, and timbers suitable for use in charcoal manufacture and available in certain districts of Burma; the wood of *Soymida febrifuga*, and records of mechanical tests of Indian timbers.

Fibres.—Jute, kapok, Marsdenia fibre, the cultivation of flax and Manila hemp, the extraction of plantain fibre, the Indian silk industry, and the manufacture of paper pulp from Indian materials. Addresses of Indian lace schools and lace makers were supplied to an enquirer on the Continent.

Essential Oils.—Ajowan seed oil; kulfa oil; lemongrass oil; sandalwood oil; turpentine oil and rosin: and wintergreen oil.

Miscellaneous.—Manufacture of cardboard containers for semi-liquid foodstuffs; processes and materials for pencil manufacture; preparation of caffeine from tea-waste; processes and plant for soap manufacture and oil-seed crushing; machinery for brass stamping, engraving, etc.; markets for Indian lacwares and toys in the United Kingdom, etc.

Indian Trade Enquiry.

This enquiry, which was undertaken by the Committee for India of the Imperial Institute at the request of the Secretary of State for India, has been continued throughout the year and the following additional reports have been completed:—

Report on the trade in Indian buffalo hides.
Memorandum on the Improvement of the quality of Indian hides.
Report on jute.
First Report on Indian timbers.
Report on the Rice Trade of India.
Supplementary Report on the Lac Trade of Burma.
Report on the Trade of India in Oilseeds.
Interim Report on Turpentine and Rosin.

List of Materials received at the Imperial Institute from Government Officers in India during the year ended 30th June 1918.

Title of Officer.	Material sent.	Number of samples.
Fibre Expert to the Government of Bengal.	Jute	1
Deputy Director of Agriculture, Northern Circle, Burma.	*Hibiscus cannabinus* fibre . .	2
Deputy Director of Agriculture, Northern Circle, Burma.	Jute	1
Deputy Director of Agriculture, Northern Circle, Burma.	Bonduc Seeds	1
Forest Economist, Dehra Dun . .	Boswellia Gum	1
Do. Do. . .	Do. Turpentine . . .	1
Do. Do. . .	Do. Rosin	2
Under Secretary to Government, United Provinces.	Sandalwood Oil	1
Under Secretary to Government, United Provinces.	Vetiver Oil	1
Under Secretary to Government, United Provinces.	Patchouli Oil	1
Under Secretary to Government, United Provinces.	Lemongrass Oil	1
Under Secretary to Government, United Provinces.	Rasa Oil	1
Under Secretary to Government, United Provinces.	Rousa Oil	1
Under Secretary to Government, United Provinces.	Gingergrass Oil	1
Under Secretary to Government, United Provinces.	Belladonna Leaves and Stems . .	2

List of Reports made by the Imperial Institute to Government officers in India during the year ended 30th June 1918.

Officer to whom Report was sent.	Subject of Report.
Director of Agriculture, Northern Circle, Burma .	Bonduc Seeds.
Forest Economist, Dehra Dun . . .	Boswellia Turpentine.
Under Secretary to Government, United Provinces	Belladonna Leaves and Stems.
Deputy Director of Agriculture, Northern Circle, Burma.	Soy Beans.
Deputy Director of Agriculture, Northern Circle, Burma.	Native Beans.
Director-General of Commercial Intelligence .	Beeswax.
Assistant Director of Agriculture, Eastern Circle, United Provinces.	Patwa fibres.
Assistant Director of Agriculture, Eastern Circle, United Provinces.	Dhencha fibres.
Director of Agriculture and Industries, Central Provinces.	Cotton.
Deputy Director of Agriculture, Southern Circle, Burma.	Rice (2 Reports).
Under Secretary of the Chief Commissioner of Assam.	Porpoise Oils.
Forest Economist, Dehra Dun.	*Helicteres Isora* fibre.
Imperial Agricultural Chemist, Pusa . . .	Sweet Potato Starch.

LIST OF PUBLICATIONS.

Agricultural Chemistry.

ANNETT, H. E. . .	Occurrence of Raffinose in the seed of the Jute plant (*Corchorus capsularis*). (*Biochemical Journal, xi.*)
BARNES, J. H. . .	Sugar and Sugarcane in the Gurdaspur District. (*Bull. No. 69, Agricultural Research Institute, Pusa.*)
DAVIS, W. A. . .	The present position and future prospects of the Natural Indigo Industry. (*Agri., Journal of India, xiii ;* pp. 32, 206.)
CLARKE, G. AND SCHRYVER, S. B.	New methods for the preparation of plant Nucleic Acids. (*Biochemical Journal, ii,* 1917, p. 319.)
FINLOW, R. S. . .	*Rhizoctonia* in Jute. The inhibiting effect of Potash manuring. (*Agri. Journ. India,* Special Indian Science Congress number, 1918, 65.)
	"Heart Damage" in Baled jute. (*Memoir Dept. Agri., India, v,* No. 2.)
FINLOW, R. S. AND McLEAN, K.	Water Hyacinth (*Eichornia crassipes*) and its value as a Fertilizer. (*Agri. Jour. India, xii,* 419.)
HARRISON, W. H. .	Report on the Extent and Character of the Saline Lands of the Madras Presidency. (*Year Book, Madras Agri. Dept.,* 1918, 13.)
" " . .	Some Notes on Manures in Southern India. (*Year Book, Madras Agri. Dept.,* 1918, 52.)
MARSDEN, F. . .	A hot water process for the extraction of Indigo as carried out in the Godaveri District of the Madras Presidency. (*Year Book, Madras Agri. Dept.,* 1918, 52.)
NARAIN, RAMJI .	Oxidases; with special reference to their presence and function in the sugarcane. (*Agri. Jour. India,* Special Indian Science Congress number, 1918, 47.)
RAO, D. ANANDA .	A preliminary experiment on the influence of different fodders on the quality and quantity of milk. (*Year Book, Madras Agri. Dept.,* 1918, 103.)
SAHASRABUDDHE, D. L.	The spice gardens of Sirsi in Kanara. (*Bull. 83, Bombay Dept. Agri.*)

SIVAN, RAMASWAMI .	A peculiar alkaline tract in South Arcot District. (*Year Book, Madras Agri. Dept.*, 1918, 25.)
SIVAN, RAMASWAMI .	Phosphatic Nodules of Trichinopoly and their availability as a manure. (*Year Book, Madras Agri. Lept.*, 1918, 34.)
TAYLOR, C. SOMERS .	Chemical control in Cane sugar factories. (*Agri. Jour. India, xii*, 532.)
VISVANATH, B. . .	A note on the best season for lifting Cus-cus Roots (*Andropogon muricatus*, Retz.). (*Year Book, Madras Agri. Dept.*, 1918, 66.)
WARTH, F. J. AND GYI, KO KO.	Prussic Acid in Burma Beans (*Bull. 79, Agri. Research Institute, Pusa.*)
" " . .	The Mandalay Milk supply. (*Bull. 15 Dept. Agri., Burma.*)

Forest Chemistry.

PEARSON, R. S. AND SINGH, PURAN.	Charcoal Briquettes. (*Ind. For., March 1918.*)
SINGH, PURAN . .	Note on the Galls of *Pistacia integerrima.* (*Ind. For., August 1917.*)
" " . . .	Effect of storage on some Tanning Materials. (*Ind. For., March 1918.*)
" " . . .	A Preliminary Note on the Manufacture of Wood-tar. (*Ind. For., April 1918.*)

Astronomy.

ROYDS, T. . .	Summary of Prominence Observations for the first half of 1917. (*Bulletin No. 57.*)
EVERSHED, J. . .	Summary of Prominence Observations for the second half of 1917. (*Bulletin No. 58.*)
" " . .	The Einstein Effect and the Eclipse of 1919, May 29. (*"Observatory," xl, 269.*)
" " . .	Day and Night "Seeing." (*"Observatory," xl, 400.*)

The following papers have been published on subjects mentioned in this Report :—

FOWLER, A. . .	Solar Prominences. (*"Observatory," xl, 359-364.*)
ST. JOHN, CHAS. E. .	The Principle of Generalized Relativity and the Displacement of Fraunhofer lines towards Red. (*Astrophysical Journal, xlvi, 249.*)

Geological Survey.

BROWN, J. C. . . Geology and Ore Deposits of the Bawdin Mines (*Rec. Geol. Surv. India, xlviii, 121-178.*)

BROWN, J. C. . . A preliminary note on the origin of wolfram-bearing lodes in Tavoy district, Lower. Burma. (*Journn As. Soc. Bengal,* new series, xii, ccii-cciii. (Abstract.)).

BURFON, R. C. . . On the origin of the Laterite of Seoni, Central Provinces. (*Rec., Geol. Surv. India, xlviii,* 204-218.)

CAMPBELL, J. MORROW Laterite; its origin, structure and minerals. (*Mining Magazine, xvii,* 67-77, 120-128, 171-179, 220-229.)

CHACKO, I. C. . . Report on the Monazite Sand Deposits in Travancore.

" " . . Annual Report of the State Geologist, Travancore, for the year 1091, M. E.

COTTER, G. DE P. . A Revised classification of the Gondwana System. (*Journ. As. Soc. Bengal,* new series, *xiii,* cciii. (Abstract); *Rec., Geol. Surv. India,* XLVIII, 23-33.)

DAS-GUPTA, H. C. . On the Zonal Distribution of *Placenticeras tamislieum* Kosmat. (*Proc. Ind. Assoc. Science, ii,* 26-40.)

" " . . Notes on some Fish Teeth from the Tertiary beds of Western India. (*Ibid., iii.* 158-160.)

" " . . On the occurrence of Limburgite in British Baluchistan. (*Journ. As. Soc. Bengal,* new series, *xiii,* cciii-cciv. [Abstract.]).

DATTA, S. C. . . On the application of Cochineal Stain on Calcite and Aragonite. (*Proc. Ind. Assoc. Science, iii,* 89-93; *Journ. As. Soc. Bengal,* new series, *xiii,* cciii. [Abstract.].)

DATTA, S. C. . . On the alteration of Pyrite occurring in Steatite (*Proc. Ind. Assoc. Science, ii,* 18-25.)

FERMOR, L. L. . . On the Crystallography and Nomenclature of Hollandite. (*Rec., Geol. Surv. India, xlviii,* 103-120.)

GRIFFITH, H. D. . . The Wolfram Deposits of Burma. (*Mining Magazine, xvii,* 60-66.)

" " . . The Kanbauk Wolfram Mine, Lower Burma. (*Ibid., xvii,* 211-218.)

HALLOWES, K. A. K. . An Account of the Sub-Division of the Deccan trap series in the neighbourhood of Narayanganj, Mandla district, Central Provinces. (*Journ. As. Soc. Bengal,* new series, *xiii,* cciii, [Abstract.].)

HAYDEN, H. H. . General Report of the Geological Survey of India for the year 1916. (*Rec., Geol. Surv. India, xlviii,* 1-22.)

" " . . The Mineral Production of India during 1916. (*Ibid., xlviii,* 35-97.)

HERON, A. M. . . Monazite in Mergui. (*Rec., Geol. Surv. India, xlviii,* 179-180.)

" " . . The Biana-Lalsot Hills in Eastern Rajputana. (*Ibid., xlviii,* 181-203.)

" " . . The Geology of North-Eastern Rajputana and Adjacent Districts. (*Mem. Geol. Surv. India, xlv,* pt. 1.)

JACK, H. S. MACLEAN The Development of the Petroleum Industry in Assam. (*Journ. Inst. Petrol., Tech., iii,* 263-286; *Journ. Roy. Soc. Arts, lxv,* 589-596.)

JONES, W. R. . . The origin of Wolfram and a Preliminary Investigation as to its persistence at depth in the Tavoy District. (*Pub. by Govt. Mining Advisory Board, Tavoy*).

LATOUCHE, T. H. D. . A Bibliography of Indian Geology and Physical Geography, with an Annotated Index of mineral of economic value. Pt. I. *Geological Survey of India.*

MIDDLEMISS, C. S. . Complexities of Archæan Geology in India. (*Journ. As. Soc. Bengal,* new series, xiii, cxcv-ccii.)

OLDHAM, R. D. . . The Structure of the Himalayas, and of the Gangetic Plain, as elucidated by Geodetic observations in India. (*Mem., Geol. Surv. India,* xlii, pt. 2.)

PILGRIM, G. E. . . Preliminary Note on some recent Manual collections from the basal beds of the Siwaliks. (*Rec., Geol. Surv. India,* xlviii, 98-101.)

REED, F. R. C. . . Ordovician and Silurian Fossils from Yunnan. (*Palæontologia Indica*, new series, vi, No. 3.)

SUBBA RAO, L. . . Corundum and its occurrence in Mysore. (*Journ. As. Soc. Bengal*, new series, xiii, cciv.). (Abstract.)

VREDENBURG, E. . Notes on the origin of the Living Molluscan Fauna of the Indian Ocean, with reference to former Geological Times. (*Journ. As. Soc. Bengal*, new series, xiii, ccii.) (Abstract.)

Botanical Survey.

BLATTER, E. . . The Palms of British India and Ceylon, XIX-XX. (*Journ. Bomb. Nat. Hist. Soc. xxv, 207-230, 386-415, with 7 plates, 1917-18.*)

BLATTER, E. & HALLBERG, F. Preliminary notes on a recent tour to the High Wavy Mountain (Southern India.) (*Journ. Bomb. Nat. Hist. Soc., xxv, 290-292, 1918.*)

" " . . New Indian *Scrophulariaceae* and some notes on the same order. (*Journ. Bom. Nat. Hist. Soc. xxv, 416-429, 1918.*)

" " . . A Revision of the Indian Species of *Rotala* and *Ammannia*. (*Journ. Bom. Nat. Hist. Soc., xxv, No. 4, 701-722, 1918.*)

" " . . Contributions towards a Flora of Persian Baluchistan and Makran. (*Journ Bom. Nat. Hist. Soc., xxv, No. 4, 723-739, 1918.*)

CRAIB, W. G. . . Diagnoses spec. nov. in herb. Hort. Reg. Bot. Edin. cognitarum. (*Notes from Roy. Bot. Gard. Edin. x, 1-78, 1917.*)

FYSON, P. F. . . Note on a malformation of the common Pine-apple (*Journ. Asiat. Soc. Beng., New Ser., xiii, 253 with 1 plate, 1917.*)

" " . . Notes on the Ecology of the Nilgiri and Pulney Highland Plateaus. (*Journ. Asiat. Soc. Beng., New Ser., xiii, 255-259, 1917.*)

GAMBLE, J. S. . Descriptions of new Indian species. (*Kew Bull., 7, 1917, p. 26-29, Decad. Kew., xc., 1917.*)

" " . . The Himalayan species of *Skimmia*. (*Kew Bull. Nos. 9 and 10, 301-303, 1917.*)

GHOSE, S. L. . . The Cone of *Selaginella pallidissima* Spr. (*Journ. Bomb. Nat. Hist. Soc., xxv, 284-289, with 1 plate, 1917.*)

HILL, A. W. . .	The genus *Strychnos* in India and the East. (*Kew Bull., 1917, Nos. 4-5, 121-210.*)
HUTCHINSON, J. . .	*Rhododendron Cuffeanum* Craib. (*Bot. Mag., 4th Ser., xiii, t. 8721, 1917.*)
" " .	*Polyalthia Parkinsonii.* (*Kew Bull., 1, p. 25, 1917.*)
" " .	Revision of *Aspidopterys.* (*Kew Bull., No. 3, 91-103, 1917.*)
" " .	*Taxotrophis* and *Balanostreblus.* (*Kew Bull., No. 4, 147-153, 1918.*)
JACOB, K. C. . .	Observations on pollination in *Alysicarpus.* (*Journ. Asiat. Soc. Beng., New Ser., xiiii, 287-292, 1917.*)
KASHYAP, S. R. .	Liverworts of the Western Himalayas and the Punjab II. (*Journ. Bomb. Nat. Hist., Soc., xxv, 279-281, 1918.*)
" " . .	Notes on *Equisetum debile* Roxb. (*Ann. Bot. xxxi, 439-445, 1917.*)
PARKER, R. N. . .	A Forest Flora for the Punjab with Hazara and Delhi (*xxv + 577, Lahore, 1918.*)
PATVARDHAN, G. B. .	Phenomena of interchangeability of Vegetative and Fruit Structures in *Opuntia elatior* Mill. (*Journ. Bomb. Nat. Hist. Soc., xxv, 513-514 with 2 plates, 1918.*)
" " .	A sport from *Opuntia elatior* Mill. (*Journ. Bomb. Nat. Hist. Soc., xxv, 514, with 1 plate, 1918.*)
PRAIN, D. . .	The genus *Chrozophora.* (*Kew Bull., Nos. 2-3, 49-120, 1918.*)
RAO, M. K. V. . .	Note on the colour of flowers in *Dysophylla stellata* Bth. (*Journ. Bomb. Nat. Hist. Soc., xxv, 312, 1918.*)
" " . .	An interesting case of distribution. (*Journ. Bomb. Nat. Hist. Soc., xxv, 313, 1918.*)
ROLFE, R. A. . .	*Odontochilus lanceolatus* Benth. (*Bot. Mag., 4th Ser., xiv, t. 8753, 1918.*)
SEDGWICK, L. J. . .	Herbaceous monsoon Flora at Castle Rock and new species of Balsam. (*Journ. Bomb. Nat. Hist. Soc., xxv, 482-485, 1918.*)
" " . .	The Cyperaceæ of the Bombay Presidency. (*Journ. Bomb. Nat. Hist. Soc., xxv, No. 4, p. 682-700, 1918.*)

SMITH, W. W. . . . Diagnoses spec. nov. in herb. Hort. Reg. Bot. Edin. cognitarum. (*Notes from Roy. Bot., Gard. Edin., x, 1-78, 1917.*)

STAPF, O. . . . *Aconitum funiculare.* (*Kew Bull., No. 1, p. 24, 1917.*)

" " . . . *Megacarpœa polyandra* Benth. (*Bot. Mag., 4th Ser. xiii, t. 8734, 1917.*)

WRIGHT, C. H. . . *Polygonum Griffithii* Hook. f. (*Bot. Mag., 4th Ser., xiii, t. 8724, 1917.*)

Agricultural Botany.

ALLAN, R. G. . . Drainage. (*The Agricultural and Co-operative Gazette*, Nagpur, *xiv, No. 5. 1918, p. 11.*)

BANNERMAN, W. B. . Cultivation of the edible date palm (*Phœnix dactylifera*) in South India. (*Journal of the Bombay Natural History Society, xxv, No. 4, 1918, p. 763.*)

BARBER, C. A. . . The origin of the Uba cane. (*International Sugar Journal*, January, 1918.) [Reprinted in the *Agricultural Journal of India, xii, 1918, p. 544.*]

" " . . Testing new seedlings in North India. (*Agricultural Journal of India, xiii, 1918, p. 243.*)

" " . . Studies in Indian sugarcanes, III. The classification of Indian canes with special reference to the Saretha and Sunnabile groups. (*Memoirs, Department of Agriculture in India (Botanical Series), ix, No. 4, 1918.*)

BLATTER, E. . . The palms of British India and Ceylon, indigenous and introduced. (*Journal of the Bombay Natural History Society, xxv, No. 3, 1918, p. 386.*)

CLOUSTON, D., AND PADMANABHA AIYER, A. R. The physical texture of soils in its relation to crop production. (*Agricultural Journal of India, Special Indian Science Congress Number, 1918, p. 89.*)

COLEMAN, L. C., AND VENKATA RAO, M.K. The cultivation of the areca palm in Mysore. (*Bulletin 10, Department of Agriculture, Mysore, 1918.*)

HOLE, R. S. . . Recent investigations on soil-aeration with special reference to forestry. (*Indian Forester, xliv, 1918, p. 202.*) [Reprinted in the *Agricultural Journal of India, xiii, 1918, p. 430.*]

HOWARD, A, . . Recent investigations on soil-aeration with special reference to agriculture. (*Indian Forester, xliv, 1918, p. 187.*) [Reprinted in the *Agricultural Journal of India, xiii, 1918, p. 416.*]

HOWARD, A., AND HOWARD, G. L. C The improvement of fruit culture in Baluchistan. (*Bulletin 9, Fruit Experiment Station, Quetta, 1918.*)

HOWARD, A., AND HOWARD, G. L. C. Some methods suitable for the study of root-development. (*Agricultural Journal of India, Special Indian Science Congress Number, 1918, p. 36.*)

HOWARD, G. L. C. . The sun-drying of vegetables. (*Bulletin 8, Fruit Experiment Station, Quetta, 1917.*)

KOTTUR, G. L. . . Note on protecting cotton flowers from natural crossing. (*Poona Agricultural College Magazine, xi, No. 3, 1918, p. 131.*)

KULKARNI, M. L. . Experiments in planting sugarcane sets with a single eye-bud and pot experiments with other seeds placed in different positions while planting. (*Agricultural Journal of India, Special Indian Science Congress Number 1918, p. 125.*)

MARRIOTT, R. G. . The sal forests of the Gorakhpur Division. (*Indian Forester, xliii, 1917, p. 442.*)

PARNELL, F. R., RANGASWAMI AYYANGAR, G. N., AND RAMIAH, K. The inheritance of characters in rice, I. *Memoirs, Department of Agriculture in India (Botanical Series), ix, No. 2, 1917.*)

TUNDI LAL . . Cambodia cotton in Chhattisgarh. (*The Agricultural and Co-operative Gazette, Nagpur, xiv, No. 5, 1918, p. 1.*)

Forest Botany.

FISCHER, C. E. C. . *Ximenia americana*, Linn. (*Ind. For., xliv, 263.*)

GLOVER, H. M. . . Fungus attack on the Deodar. (*Ind. For., xliii, 498.*)

HAINES, H. H. . . Unsoundness of Sal. (*Ind. For., xliii, 306.*)

" " . . Note on *Urginea indica*, Kunth. (*Ind. For., xliii, 337.*)

HOLE, R. S. . . . Indian species of *Grewia*. (*Ind. For., xliii, 312.*)

" " . . . Notes from Dehra Dun herbarium. (*Ind. For., xliii, 410.*)

" " . . . Balsa wood. (*Ind. For., xliii, 411.*)

" " . . . Cause of Spike Disease of Sandal. (*Ind. For., xliii, 429.*)

" " . . . Best method of working *ulla* grasslands. (*Ind. For., xliii, 479.*)

HOLE, R. S. AND HOWARD, A. Recent investigations on Soil-æration. (*Ind. For., xliv, 187.*)

HOWARD, A. AND HOLE, R. S. Recent investigations on Soil-æration. (*Ind. For., xliv , 187.*)

LENOX-CONYNGHAM, G. P. Motion of bench-marks fixed to trees. (*Ind. For., xliii, 504.*)

LUSHINGTON, P. M. . *Anacolosa densiflora*. (*Ind. For., xliii, 503.*)

" " . Spike Disease in Sandal. (*Ind. For. xliv, 114.*)

MARRIOTT, R. G. . Sal Forests of Gorakhpur. (*Ind. For., xliii, 442.*)

MC RAE, W. . . . Growth of the Palmyra Palm. (*Ind. For., xliii, 25.*)

NARASIMHAN, M. J. . Root-nodules of Casuarina. (*Ind. For., xliv, 265.*)

OSMASTON, B. B. . Rate of Growth of Bamboos. (*Ind. For., xliv, 52.*)

PARKER, R. N. . . Forest Flora of the Punjab.

RAMA RAO, M. . . Field investigation of Spike Disease in Sandal. (*Ind. For., xliv, 58.*)

TRAFFORD, F. . . . Natural root-grafting. (*Ind. For., xliii, 515.*)

TREVOR, C. G. . . . Fungus attack on the Deodar. (*Ind. For., xliv, 130.*)

Mycology.

AYYAR VENKATARAMA, R. K. Is Spike Disease of Sandal (*Santalum album*) due to an unbalanced Circulation of Sap. (*Ind. For., xliv, No. 7, 1918.*)

ANSTEAD, R. D. . . . The Treatment of Fungoid Diseases on Estates. (*Planter's Chronicle, xii, No. 38, 1917.*)

Annual Reports of the Agricultural Research Institute, Pusa, and of Provincial Departments of Agriculture.

BUTLER, E. J. . .	Immunity and Disease in Plants. (*Agr. Journ. India, Science Congress, November 1918.*)
,, ,, . .	Fungi and Disease in Plants, 1918.
FINLOW, R. S. . .	Rhizoctonia in Jute : The inhibiting effect of Potash Manuring. (*Agr. Journ. India Science Congress, No. , 1918.*)
GLOWER, H. M. . .	A fungus attack on the Deodar. (*Ind. For., xliii, Nos. 11 and 12, 1917.*)
HOLE, R. S. . . .	Cause of the spike disease of sandal (*Santalum album*). (*Ind. For., xliii, No. 10, 1917.*)
HODGSON, C. M. . .	Spiked Sandal Wood. (*Ind. For., xliv, No. 2, 1918.*)
KULKARNI, G. S. . .	Smuts of jowar (Sorghum) in the Bombay Presidency. (*Agr. Res. Inst. Bul., No. 78, 1918.*)
LUSHINGTON, P. M. .	Spike disease in Sandal. (*Ind. For., xliv, No. 3, 1918.*)
McRAE, W. . . .	Note on *Phytophthora Meadii* on *Hevea brasiliensis*. (*Bomb. Nat. Hist. Soc. Journ., xxv.*)
,, ,, . .	Fungoid Diseases of Rubber in Southern India. (*Planters Chronicle, xiii, No. 23, 1918.*)
McRAE, W. AND ANSTEAD, R. D.	Abnormal Leaf-fall of Hevea. (*Planters Chronicle, xii, No. 3, 1917.*)
SHAW, F. J. F. . .	*Orobanche* as a parasite in Bihar. (*Mem. Dept. Agr. India, Bot. Ser., ix, No. 3, 1917.*)
SPROTT, W. H. . .	Spraying of Coffee. (*Planters Chronicle, xii, No. 43, 1917.*)
TUNSTALL, A. C. . .	The Spraying of Tea in North-East India. (*Agr. Journ. Ind. Science Congress, No. , 1918.*)

Agricultural Bacteriology.

FINLOW, R. S. . .	"Heart Damage" in baled Jute. (*Mem. Dept. Agr. India, Chem. Ser. v, No. 2.*)

Silviculture.

ANON . . .	A study of labour conditions in United Provinces Plains Division. (*Ind. For., xliv, 45.*)
BEESON, C. F. C. .	A Forest Journal. (*Ind. For., xliv, 176.*)
BENSKIN, E. AND RODGER, A.	Note on Thitsi. (*Ind. Forest Record, vi, Part III.*)

BLANFORD, H. R. .	Teak Regeneration under the Uniform System in Mohnyin, Upper Burma. (*Ind. For., xliii, 339.*)
BUTTERWICK, A. J. .	Stray Notes on the Working of Teak in Burma. (*Ind. For., xliii, 488.*)
COOPER, G. M. . .	The Unsoundness of Sal in Chota Nagpur and Orissa. (*Ind. For., xliii, 304.*)
DAVIS, A. P. . .	Working Plan for the Indaung Working Circle, Ruby Mines Division, Southern Circle, Burma.
" " . .	Working Plan for the Plains Reserve, Meiktila Division, Southern Circle, Burma.
DAWKINS, C. G. E. .	Working Plan for the Kyaw and Yawdwin Working Circles in the Yaw Forest Division, Southern Circle, Burma.
FISCHER, C. E. C. .	*Ximenia americana.* (*Ind. For., xliv, 263.*)
GLOVER, H. M. . .	A Fungus attack on the Deodar. (*Ind. For., xliii, 498.*)
HAINES, H. H. . .	The Unsoundness of Sal. (*Ind. For., xliii, 306.*)
HART, G. S. . .	Note on a tour of Inspection in some of the Forests of Central, Northern and Southern Circles, Bombay Presidency.
" " . .	Note on a tour of Inspection in the Forests of Burma.
" " . .	Note on a tour of Inspection in the Forests of the Bashahr Division.
HODGSON, C. M. . .	Spiked Sandalwood. (*Ind. For., xliv, 66.*)
HOLE, R. S. . .	Best Method of Working Ulla Grasslands. (*Ind. For., xliii, 479.*)
" " . .	Cause of the Spike disease of Sandal. (*Ind. For., xliii, 429.*)
" " . .	Indian Species of *Grewia* of Forest Importance (*Ind. For., xliii, 312.*)
HOLE, R. S. AND HOWARD, ALBERT.	Recent Investigations on Soil-æration. (*Ind. For., xliv, 187.*)
HOPWOOD, S. F. . .	Working Plan for the North and South Gangaw Working Circle, Yaw Division, Southern Circle, Burma.
HOWARD, ALBERT AND HOLE, R. S.	Recent Investigations on Soil-æration. (*Ind. For., xliv, 187.*)
HOWARD, S. H. . .	Artificial Regeneration of Shisham. (*Ind. For., xliv, 137.*)

ICONOCLAST . .	A Forest Journal. (*Ind For., xliv, 135.*)
JERRAM, M. R. K. .	A Forest Journal. (*Ind. For., xliv, 178.*)
KARUNAKARA MENON, C.	A few notes on *Hopea parviflora*. (*Ind. For., xliv, 275.*)
LENOX-CONYNGHAM, G. P.	Report on the Levelling carried out to ascertain the motion, if any, of bench-marks fixed to trees in the compound of the Trigonometrical Survey Office, Dehra Dun, during the period April 1914 to April 1917. (*Ind. For., xliii, 504.*)
LUSHINGTON, P. M. .	*Anacolosa densiflora*. (*Ind. For., xliv, 503.*)
" " .	Spike disease in Sandal. An interesting isolated area and its treatment. (*Ind. For., xliv, 114.*)
MAITLAND KIRWAN, J. .	Note on Babul [*Acacia arabica* Willd.]. (*Forest Bulletin No. 35.*)
MARRIOTT, R G. .	The Sal Forests of Gorakhpur. (*Ind. For., xliii, 442.*)
MARSDEN, EDWARD .	Comparative Yearly Volume-increments of certain Indian tree crops. (*Ind. For., xliv, 10.*)
" " .	Method of working bamboos. (*Ind. For., xliv, 147.*)
" " .	Note on the Silviculture of tan-yielding trees. (Proceedings of Tannin Conference, Dehra Dun, August 1917.)
" " .	Statistics compiled in the office of the Silviculturist, 1916-17. (*Ind. For. Record, Vol. VI, Pt. V.*)
" " .	The Economic Aspect of Indian Silviculture. (*Indian Science Congress, 1918.*)
MASCARENHAS, L. P. .	Artificial Propagation of Sandal. (*Ind. For., xliv, 72.*)
MATHRA PRASAD BHOLA	Experimental sowing and planting of *Cupressus glabra* in Garhwal. (*Ind. For., xliv, 228.*)
" " .	Germination of *Cupressus torulosa* seed. (*Ind. For., xliv, 175.*)
MCRAE, W. . .	Growth of the Palmyra Palm. (*Ind. For., xliv, 25.*)
MILROY, A. J. W. .	Wanted a Forest Policy for Assam. (*Ind. For., xliv, 100.*)
MUDALIOR, A. P. .	Some Notes on Sandal in the Sambalpur Division, Bihar and Orissa. (*Ind. For., xliii, 318.*)
NARASIMHAN, M. J. .	A preliminary study of the root-nodules of *Casuarina*. (*Ind. For., xliv, 265.*)
NAVNANI, DALPATRAI .	Revised Working Plan for the Hyderabad Forest Division, Sind Circle.

OSMASTON, B. B. .	Rate of Growth of Bamboos. (*Ind. For., xliv* 52.)
PEARSON, R. S. . .	Note on Kokan or Lampatia. (*Forest Bulletin No. 36.*)
PHILIPP, C. H. . .	Working Plan for the Kadat, Letpan, Anngmya, Pyinma, Talaingma, Shwelaung-Kodugwe and Kalein Reserves, Pegu Division, and the Paunglin Reserve, Rangoon Division, to be known as Zaungtu Working Plan.
RAMA RAO, M. . .	Field investigations of Spike disease in Sandal on the Kollimalai hills. (*Ind. For., xliv, 58.*)
RODGER, A. AND BENSKIN, E.	Note on Thitsi. (*Ind. Forest Record, Vol. VI, Part III.*)
SHEBBEARE, E. O. .	A Forest Journal. (*Ind. For., xliii, 512.*)
STARTE, H. W. .	Anjan (*Hardwickia binata*) Coppice. (*Ind. For., xliv, 268.*)
TIREMAN, H. . .	Measurements of a Teak tree felled in the South Coorg forests. (*Ind. For., xliv, 86.*)
TRAFFORD, F. . .	Arboriculture III. Tending of Avenues. (*Ind. For., xliv, 123.*)
" " . .	Natural Root grafting. (*Ind. For., xliii, 515.*)
TREVOR, C. G. . .	A Forest Journal. (*Ind. For., xliv, 131.*)
" " . .	A Fungus attack on the Deodar. (*Ind. For., xliv, 130.*)
WATSON, H. W. A. .	Forestry in Lower Burma. (*Ind. For., xliv, 212.*)

Forest Products.

FISH, F. K. . .	New process of vulcanizing lumber. (*Lumber World Review, Decr. 10, 1917, 36.*)
HAMILTON, J. D. . .	Note on Jungle-wood Shingles. (*Ind. For., xliv, 217.*)
KIRWAN, J. D. M. .	Note on Babul, *Acacia arabica*. (*Forest Bulletin No. 35 of 1917.*)
MATHRA PRASAD BHOLA	Paper making from *Daphne cannabina*. (*Ind. For., xliv, 125.*)
PALMER, R. C. . .	Yields from the Destructive Distillation of certain Hard-woods. (*U. S. Dept. of Agr. Bulletin No. 508.*)
PEARSON, R. S. . .	A further note on the Antiseptic Treatment of Timber recording results obtained from past experiments. (*Forest Records, Vol. VI, Part IV.*)

PEARSON, R. S. . . Note on Kokan or Lampatia Timber, *Duabanga sonneratioides.* (*Forest Bulletin No. 36 of 1917.*)

" " . Note on the Contraction and Warping which takes place in *Pinus longifolia* timber while seasoning (*Forest Bulletin No. 37 of 1917.*)

" " . Note on the Strength of Glues. (*Ind. For., xliii, 336.*)

PEARSON, R. S. AND PURAN SINGH. Note on the Preparation of Turpentine, Rosin and Gum from *Boswellia serrata.* (In the Press.)

" " . Note on Charcoal Briquettes. (*Ind. For., xliv, 118.*)

PURAN SINGH . . A Preliminary Note on the Manufacture of Wood Tar. (*Ind. For., xliv, 141.*)

" " . . Note on the Galls of *Pistacia integerrima.* (*Ind. For., xliii, 366.*)

" " . . Effect of Storage on Some Tanning Materials. (*Ind. For., xliv, 91.*)

" " . . (1) Note on Eucalyptus Oil Industry in the Nilgiris. (2) Note on Distillation of Geranium Oil in the Nilgiris. (3) Note on Manufacture of Wintergreen Oil in India. (*Ind. For. Records, Vol. V, Part VIII.*)

RODGER, A. AND BENSKIN, E. Note on Thitsi, *Melanorrhœa usitata,* with special reference to the Oleo-resin obtained from it. (*Ind. For. Records, Vol. VI., Part III.*)

SINGTON, T. . . Notes for the use of Dye-woods. (*Ind. For., xliv, 173.*)

STONE, HERBERT . . The Density of Wood. (*Timber Trades Journal, lxxxiii, 783.*)

" " . . The Strength of Wood. (*Timber Trades Journal, lxxxiii, 725.*)

TIEMANN, HARDY D. . The theory of Drying and its application to the new humidity-regulated and re-circulating Dry ,Kiln. (*U. S. Dept. of Agri. Bulletin No. 509.*)

Zoology.

General.

ANNANDALE, N. . . Fauna on the Inlé Lake. Introductory Account. (*Rec. Ind. Mus., xiv, 1.*)

" " . . Fauna of the Inlé Lake. Summary of Results. (*Rec. Ind. Mus., xiv, 195.*)

Protozoa.

CHALMERS, A. J. AND PEKKOLA, W. — *Chilomastix mesnili* (Wenyon). (*Ann. Trop. Med. Prasit. xi, 213.*)

CRAGG, F. W. AND NAIDU, G. K. — A case of Malaria showing Atypical Parasites. (*Ind. Journ. Med. Research, v, 458.*)

GHOSH, E. . . . Studies on Infusoria. (*Rec. Ind. Mus., xv, 129.*)

HORNELL, J. . . . A new Protozoan cause of widespread mortality among marine fishes. (*Madras Fish. Bull., xi, 53.*)

Porifera.

ANNANDALE, N. . . . Sponges, Hydrozoa and Polyzoa of the Inlé Lake. (*Rec. Ind. Mus., xiv, 75.*)

" " . . . Sponges, Zoological results of a tour in the Far East—Part IV. (*Mem. Asiat. Soc. Bengal, vi, 193.*)

Coelentera.

ANNANDALE, N. . . . Sponges, Hydrozoa and Polyzoa of the Inlé Lake. (*Rec. Ind. Mus., xiv, 78.*)

Echinodermata.

HORNELL, J. . . . The Indian Beche-De-Mer Industry : its history and recent revival. (*Madras Fish. Bull., xi, 119.*)

KABURAKI, T. . . . Freshwater Triclads from the Basin of the Inlé Lake. (*Rec. Ind. Mus., xiv, 189*)

" " . . . Brackish-water Polyclads. Zoological results of a tour in the Far East—Part IV. (*Mem. Asait. Soc. Bengal, VI, 183.*)

Unsegmented worms.

LISTON, W. G. AND SOPARKAR, M. B. — Bilharziosis among animals in India. The life-cycle of *Schistosomum spindalis*. (*Ind. Journ. Med. Research, v, 567.*)

SOPARKAR, M. B. . . . A Trematode Parasite of Anopheline Mosquitos. (*Ind. Journ. Med. Research, v, 512.*)

SOUTHWELL, T. AND PRASHD, B. — Notes from the Bengal Fisheries Laboratory No. 4. Cestode Parasites of Hilsa. (*Rec. Ind. Mus., xv, 77.*)

" " . . . Methods of asexual and parthenogenetic reproduction in Cestodes. (*Journ. Parasit., iv, 122.*)

SOUTHWELL, T. AND PRASHAD, B. . On the anatomy and life-history of *Rhynchobothrius ilisha*, n. sp., from the intestine of a shark, Carcharinus gangeticus (Mull. & Henle). (*Journ. Asiat. Soc. Bengal, N. S., xiv, cli.*)

" " . A description of a cestode parasite of doubtful systematic position, from the mesentery and liver of Hilsa. (*Ibid, cli.*)

Annelida.

STEPHENSON, J. . . On the so-called Pharyngeal Gland-Cells of Earthworms. (*Quart. Journ. Micros. Sci., lxii (N. S.), 253.*)

" " . . Aquatic Oligochæta of the Inlé Lake. (*Rec. Ind. Mus., xiv, 9.*)

STEPHENSON, J. AND PRASHAD, B. The calcareous glands of Earthworms. (*Journ. Asiat. Soc. Bengal, xiv (N. S.), clii.*)

THAPAR, G. S. . . The lymph glands in the genus *Pheretima* with a note on the cœlomic organ of Beddard. (*Rec. Ind. Mus., xv, 69.*)

ZIBBU, P. S. K. . . The valves of the blood vessels in the genus *Pheretima.* (*Journ. Asiat. Soc. Bengal, xiv (N. S.), cliii.*)

Crustacea.

CALMAN, W. T. . . On Barnacles of the genus *Scalpellum* from Deep-sea Telegraph-cables. (*Ann. Mag. Nat. Hist. (9th Ser.), i, 96.*)

KEMP, S. W. . . Fauna of the Inlé Lake. Crustacea Decapoda of the Inlé Lake Basin. (*Rec. Ind. Mus., xiv, 81.*)

Arachnoidea.

FISCHER, C. E. C. . Examples of mimicry in spiders. (*Journ. Bombay Nat. Hist. Soc., xxv, 760.*)

Insecta.

(See Report on Economic Entomology.)

Polyzoa.

ANNANDALE, N. . Sponges, Hydrozoa and Polyzoa of the Inlé Lake. (*Rec. Ind. Mus., xiv, 78.*)

Mollusca.

ANNANDALE, N. . . Aquatic Molluscs of the Inlé Lake and connected waters. (*Rec. Ind. Mus., xiv, 103.*)

" " . . A new species of Taia from the Chindwin Valley, Upper Burma. (*Rec. Ind. Mus., xiv, 213.*)

" " . . Freshwater Shells from Mesopotamia. (*Rec. Ind. Mus., xv, 159.*)

" " . . Plasticity and evolution among the aquatic molluscs of the Inlé Lake in the Southern Shan States. (*Journ. Asiat. Soc. Bengal, xiv (N. S.), cl.*)

GHOSH, E. . . On the anatomy of certain Indian Unionidæ. (*Rec. Ind. Mus., xv, 109.*)

GODWIN AUSTEN, H. H. New species of Slug-like Molluscs belonging to the Family Zonitidæ from the Dawna Hills, Tenasserim. (*Rec. Ind. Mus., xv, 149.*)

PRASHAD, B. . . Studies on the Anatomy of Indian Mollusca. (I. The Marsupium and Glochidium of the genus *Physunio*. (*Rec. Ind. Mus., xiv, 183.*)

" " . . Studies on the Anatomy of Indian Mollusca. No. 2 (*Rec. Ind. Mus., xv, 143.*)

Fishes.

ANNANDALE, N. . . A note on the Fisheries of the Inlé Lake, Southern Shan States. (*Rangoon, 1917.*)

" " . . Fish and Fisheries of the Inlé Lake. (*Rec. Ind. Mus., xiv, 33.*)

" " . . A primitive Eel from the Southern Shan States. (*Journ. Asiat. Soc. Bengal, xiv (N. S.) cli.*)

CHAUDHURI, B. L. . A short historical sketch of the study of Indian Ichthyology. Presidential address, Section Zoology, Fifth Indian Science Congress. (*Journ. Asiat. Soc. Bengal, xiv (N. S.), cxxxviii.*)

GILCHRIST, J. D. F. . The eggs and spawning habits of the Pilot Fish (*Naucrates ductor*). (*Ann. Mag. Nat. Hist., 9th Ser., II, 114.*)

HORNELL, J. . . A Statistical Analysis of the Fishing Industry of Tuticorin (South India). (*Rep. No. 3 (1917), Madras Fish. Bull., xi.*)

NARAYAN RAO, C. R. . Notes on the life history of *Ophiocephalus punctatus*, Bloch. (*Journ. Asiat. Soc. Bengal, xiv (N. S.), clv.*)

SOUTHWELL, T. AND PRASHAD, B. — On Hilsa investigation in Bengal, Bihar and Orissa. (*Bull. No. 11, Dept. Fish., Bengal and Bihar and Orissa.*)

WHITEHOUSE, R. H. . The caudal fin of the Eel *Chaudhuria.* (*Rec. Ind. Mus., xiv, 65.*)

" " . The evolution of the caudal fin of fishes. (*Rec. Ind. Mus., xv, 135.*)

Batrachia.

ANNANDALE, N. . . Chelonia and Batrachia of the Inlé Lake. (*Rec. Ind. Mus., xiv, 67.*)

" " . . Some undescribed Tadpoles from the Hills of Southern India. (*Ibid, xv, 17.*)

ANNANDALE, N. AND NARAYAN RAO, C. R. — The Tadpoles of the families Ranidæ and Bufanidæ found in the plains of India. (*Rec. Ind. Mus., xv, 25.*)

BOULENGER, G. A. . Descriptions of New Frogs of the genus *Rana.* (*Ann. Mag. Nat. Hist., 8th Ser., xx, 413.*)

" " . Remarks on the Batrachian genera *Corfufer, Tschudi, Platymantis,* Gthr., *Simomantis,* g.n., and *Staurois,* Cope. (*Ibid, 9th Ser., i, 372.*)

BOULENGER, G. A. AND ANNANDALE, N. — Further observations on *Rana tigrina.* (*Rec. Ind. Mus., xv, 51.*)

NARAYAN RAO, C. R. . Notes on the Tadpoles of Indian Engystomatidæ. (*Ibid., xv, 41.*)

PRASHAD, B. . . The Middle Ear of Indian Frogs. (*Ibid., xv, p. 97.*)

Reptiles.

ANNANDALE, N. . . Chelonia and Batrachia of the Inlé Lake. (*Rec. Ind. Mus., xiv, 67.*)

BOULENGER, G. A. . A revision of the Lizards of the genus *Tachydromus.* (*Mem. Asiat. Soc. Bengal, v, 207.*)

" " . A synopsis of the Lizards of the genus *Eremias.* (*Journ. Zool. Research, iii, 1.*)

BURTON, R. W. . . Habits of the Green Turtle (*Chelone mydas*). (*Journ. Bombay Nat. Hist. Soc., xxv, 508.*)

D'ABREU, E. A. . . Pythons breeding in captivity. (*Ioid., xxv, 509.*)

" " . . On an undescribed colour variety of the snake (*Zaocys mucosus*) from the Central Provinces. (*Ibid., 753.*)

WALL, F. . . . A popular treatise on the common Indian Snakes, Parts XXIV and XXV. (*Ibid*, 375, 628.)

" " . . . Occurrence of the Tree Snake (*Dendrophis pictus*) in Kumaon. (*Ibid*, 509.)

" " . . . Notes on a collection of Sea Snakes from Madras. (*Ibid.*, 599.)

" " . . . Notes on a gravid *Hydrophis cyanocinctus* and her Brood. (*Ibid.*, 754.)

" " . . . Note on the breeding of the Rasp-skinned Water Snake *Chersydrus granulatus*, Schneider. (*Ibid.* 756.)

WATSON, H. R. . . Cobras without the cuneate scales. (*Ibid.*, 510.)

Birds.

BAKER, E. C. S. . The Game Birds of India, Burma and Ceylon, Parts XXIII and XXIV. (*Journ. Bombay Nat. Hist. Soc.*, *xxv*, 325, 521.)

" " . Notes on the nidification of some Indian Falconidæ. III. The Genera *Ictinætus* and *Microhierax*. (*Ibid*, 10*th Ser.*, *vi*, 51.)

BHATTACHARYA, D. R. . Notes on the anatomy of double Monstrosity in the Chick. [*Journ. Pro. Asiat. Soc. Bengal* (*N. S.*) *xiv*, 333.]

D'ABREU, E. A. . The food of Birds in the Central Provinces. (*Rec. Nagpur Mus.*, *ii.*)

DONALD, C. H. . . The Raptores of the Punjab. (*Journ. Bombay Nat. Hist. Soc.*, *xxv*, 231.)

" " The occurrence of the Indian Pitta (*Pitta brachyura*) in the Kangra District, Punjab. (*Ibid.*, 497.)

GIBSON, R. E. . . Comb Duck (*Sarcidiornis melanonotus*) in Sind. (*Ibid.*, 747.)

HALL, E. F. . . Notes on the nidification of the Common Grey Hornbill (*Lophoceros birostris*). (*Ibid*, 503.)

INGLIS, C. M. . . Some notes on the Burmese Peafowl (*Pavo muticus*) in captivity. (*Ibid.*, 500.)

" " . . Black-Headed Sibia (*Lioptila capistrata*) in the Jalpaiguri District, Bengal. (*Ibid.*, 742.)

" " . Occurrence of the white-tailed Blue Robin (*Notodela leucura*) in the Buxa Duoars District, Bengal. (*Ibid.*)

IRELAND, S. G. C. . Nidification of the Lesser or common Whistling Teal (*Dendrocyena javanica*) and Bonelli's Eagle (*Hieraetus fasciatus*). (*Ibid.*, *499.*)

MACKENZIE, J. M. D. . Some further notes on Cuckoos in Maymyo. (*Ibid.*, *742.*)

" " . A few notes on the nests and eggs on some of the Burmese Scimitar Babblers. (*Ibid.*, *748.*)

MATTHEWS, W. H. . Birds-Nesting in the Bhillung Valley, Tehri Garhwal. (*Ibid.*, *495.*)

OSMASTON, B. B. . The case for the Woodpecker. (*Ind. Forester, xiii*, *525.*)

" " . Notes on Birds-Nesting in the Tons Valley (*Journ. Bombay Nat. Hist. Soc. xxv, 493.*)

ROBINSON, H. C. . On two abnormal Specimens of Ducks in the collection of the Zoological Survey of India. (*Rec. Ind. Mus., xv, 47.*)

ROOS-KEPPEL, G. . Occurrence of the European Great Bustard, *Otis tarda*, near Peshawar. (*Journ. Bombay Nat. Hist. Soc., xxv, 745.*)

WICKHAM, P. W. D. . Miscellaneous notes on some Birds in the Chin Hills, Burma. (*Ibid.*, *750.*)

WHISTLER, H. . . Notes on the Birds of Ambala District, Punjab. (*Ibid.*, *665*).

" " . . An addition to the Indian list of Birds. (*Ibid.*, *742.*)

" " . . The White-Necked Stork in the Punjab. (*Ibid.*, *746.*)

Mammalia.

ANDREWS, R. C. . . A note on the skeletons of *Balænoptera edeni*, Anderson, in the Indian Museum Calcutta. (*Rec. Ind. Mus., xv, 105.*)

BABAULT, M. G. . Les mœurs des Pteromys de l'Inde. (*Bull. Mus. Nat. Hist. Natur., viii, 1916, 430.*)

KLOSS, C. B. . . Notes on some Hares in the Indian Museum, with descriptions of two new forms. (*Rec. Ind. Mus., xv, 89.*)

MILNE, G. . . Note on Cattle in Bihar and Orissa.

OTTEN, L. . . About the biology of *Mus concolor*. (*Mededeel. Burgerl. Genees. Dien. Nederlandsch-Indie, vi, 1917, 82.*)

POCOCK, R. I. . . Further notes on some external characters of the Bears (Ursidæ). (*Ann. Mag. Nat. Hist., 9th Ser., i, 375.*)

ROBINSON, H. C. . A new race of Hare from the Persian Frontier of Mesopotamia. (*Rec. Ind. Mus.*, *xv*, *49.*)

THOMAS, O. . . The nomenclature of the Geographical forms of the Panolia Deer (*Rucervus eldi* and its relatives). (*Journ. Bombay Nat. Hist. Soc.*, *xxv*, *363.*)

" " . . A selection of lectotypes of Indian Mammalia from the co-types described by Hodgson, Gray, Elliot and others. (*Ibid*, *368.*)

" " . . The generic division of the Hedgehogs. (*Ann. Mag. Nat. Hist.*, *9th Ser.*, *i*, *196.*)

" " . . On the allocation of the name *Sciurus finlaysoni* Horsfield (*Journ. Nat. Hist. Soc. Siam*, *ii*, *343.*).

WROUGHTON, R. C. . The Shan States Langur, a correction. (*Journ. Bombay Nat. Hist. Soc.*, *xxv*, *361.*)

" " . A new Indian Hare, *Lepus Rajput.* (*Ibid*, *361.*)

" " . Summary of the Results from the Indian Mammal Survey of the Bombay Natural History Society. (*Ibid.*, *547.*)

WROUGHTON, R. C. AND DAVIDSON, W. M. Bombay Natural History Society's Mammal Survey of India, Burma and Ceylon. Report No. 29, Pegu. (*Journ. Bombay Nat. Hist. Soc.*, *xxv*, *472.*)

Agricultural Entomology.

ANDREWS, E. A. . On Insects, Part V. (*Qrly. Journ. Indian Tea Association*, *vi*, *41-47.*)

" " . Insect Pests of Tea in North-East India during the season 1916. (*l.c. vii*, *75-79.*)

ANSTEAD, R. D. . Deputy Director of Agriculture's Tour in the Shevaroys (*Planters' Chronicle*, *xiii*, *56-60.*) [Remedial measures against cut-worms and other insect pests of vegetables.]

AWATI, P. R. . . Studies in Flies, III. Classification of the genus *Musca* and description of the Indian species. (*Ind. Journ. Med. Res.*, *v*, *160-191*, *tabs. 20-29.*)

" " . . A new larviparous *Philæmatomyia* (*Ph. indica n. sp.*). (*Ind. Journ. Med. Res.*, *v*, *529-539*, *tab. 50-55.*)

BACK, E. A. AND The Melon Fly in Hawaii. (*U. S. Dept. Agric.*,

PEMBERTON, C. E. *Bulletin* No. 491; 64 pp., 10 figs., 24 tabs.) [An account of *Chætodacus cucurbitæ* including Indian records.]

BAGNALL, R. S. . Brief Descriptions of new Thysanoptera, ix. (*Ann. Mag. Nat. Hist. (9) i, 201-221.*) [*Aptinothrips ruficornis* var. *connaticornis*, Uzel, in tea-flowers at Lebong, p. 205: *Physothrips brunneicornis*, Bagn., on rose, Darjiling Distr., p. 206; *Physothrips, peculiaris*, n. sp., Pusa, on lucerne, pp. 206-207; *Haplothrips tenuipennis*, n. sp., on tea and rose, Darjiling District, pp. 210-211.]

BAGNALL, R. S. . . On two species of *Physothrips* (Thysanoptera) injurious to tea in India. (*Bull. Ent. Res., ix, 61-64, 2 figs.*) [*Ph. setiventris*, n. sp., *Ph. lefroyi*, Bagn. : from Darjiling.]

BAKER, A. C. . . On the Chinese Gall. (*Entl. News, xxviii, 385-393, tab. xxvi.*) [Galls produced on *Rhus semialata* by *Melaphis chinensis*. Similar galls are found on this tree in the Khasi Hills.]

BANNERMAN, W. B. . . Note on the habits of the Deaths-head Moth *Acherontia styx*. (*Bombay Nat. Hist. Soc. Journ., xxv, 759-760.*)

BEESON, C. F. C. . Forest Entomology (*Annual Report Board Scientific Advice for India, 1916-17, pp. 96-98, 158.*)

" " . . Forests Insect Conditions in India. (*Agricl. Journ., Ind., Sci. Congr. Number 1918, 114-124.*)

BELL, T. R. . . The Common Butterflies of the Plains of India, Part XIX. (*Journ. Bombay Nat. Hist. Soc., xxv 430-453, one fig.*)

" " . . The Common Butterflies of the Plains of India, Part XX. (*l.c., 636-664, fig.*)

BEZZI, M. . . Studies in Philippine Diptera, II. (*Phil. Journ. Science, xii, Sect. D, 107-159, 1 tab.*) [Several Indian species included.]

BOURGOIN, A. . . Notes sur *Macronota flavofasciata*, Moser, et sur les espèces voisines. (*Bull. Soc. Ent. France, 1918, 56-57.*)

" " . . . Description de deux *Diceros* nouveaux (Col. Scarabæidæ). (*Bull. Soc. Ent. France, 1917, 277-279.*) [*D. nigrocyaneus* n. sp., Yunnan, pp. 277-278.]

" " . . Trois espèces nouvelles de *Macronota* (Scarabæidæ). (*l.c., pp. 321-325*). [*M. luteovaria*, n. sp., Yunnan, pp. 324-325.]

BUGNION, E. . . . [Instructions destinées aux Collectioneurs de Termites. (*Bull. Soc. nat. d'Acclimitation de France*, December 1917; sep. pp. 1-9.) Deals) principally with Ceylon termites.]

BURN, F. N. . . . Insects in Burmese Amber. (*Entom, li, 102-103.*) [Calls attention to Cockerell's papers on fossil insects in Burmite].

BURR, M. . . . . Contribution à la Faune entomologique de l'Indo-Chine Francaise; Dermaptères. (*Ann. Soc. Ent. France, lxxxvi, 57-62.*) [Several Indian species.]

CAMERON, M. . . . New Oriental Staphylinidae (1). (*Ent. Mo. Mag. liv, 102-105.*) [*Platystethus robustus*, n. sp., Nilgiris, pp. 102-103; *Stenus confluens*, n. sp., Lebong, p. 103; *Staphylinus bryanti*, n. sp., Kandy, pp. 104-105; *Rhynchocheilus andrewesi*, n. sp., Nilgiris, p. 105.]

CARPENTER, G. H. . Collembola (of the Abor Expedition). (*Rec. Ind. Mus., viii, 561-568, tab. 55-57.*) (six new spp.)

CHAMPION, G. C. . New and little-known saltatorial Dascillidæ. (*Ent. Mo. Mag., liv, 130-144.*) [*Ora picta*. Fb., S., India and Ceylon, p. 140; *O. atrosignata*, n. sp., Patkai Hills, pp. 140-141; *O. nigropunctata* Mots., Colombo, p. 141; *O. compressa*, n. sp. Kandy, Dikoya, p. 143.]

COCKERELL, T. D. A. . Insects in Burmese Amber. (*Ann. Ent. Soc. America, x, 323-329.*) [*Acmæ-odera burmitina*, n. sp. (Buprestidae), p. 323, f. 1; *Eurygenius wickhami*, n. sp., (Pedilidae), pp. 324-325, f. 2; *Elater burmitinus*, n. sp. (Elateridae), p. 325, f. 3; *Burmacrocera*, n. g. (Mycetophilidae) *petiolata*, n. sp., pp. 326-327, ff. 4, 5; *Plecophlebus* (Trichoptera, ? Odontoceridae), n. g. *nebulosus*, n. sp. pp. 327-328, f. 7; *Hodotermes tristis*, n. sp. (Isoptera), p. 329, f. 10; *Liburnia burmitina*, n. sp. p. 329, ff. 8, 9; *Burmitempis halteralis*, f. 6.]

COLEMAN, L. C. AND VENKATA RAO, M. K. The cultivation of the Areca Palm in Mysore (*Mysore Agric. Dept. Bulletin No. 10, p. 32* text-fig. 1, tabs. 6.) [p. 20, Insect Pests.]

" " . Coffee Borer. (*Planters' Chronicle, xii, 579*).

CORNWALL, J. W. AND MENON, T. KESAVA. On the possibility of the transmission of Plague by Bed-Bugs. (*Ind. Journ. Med. Res. v, 137-159.*)

CRAGG, F. W. . The mouth parts of *Ochromyia jejuna*, a predaceous Muscid. (*Ind. Journ. Med. Res. v*, 516-522, *t. 48*.)

CRAWFORD, D. L. . Philippine and Asiatic Psyllidae. (*Phil. Journ. Science*, Vol. XII, Sect. D., 163-174, 1 tab.) [*Euphalerus citri* from India and Philippines; *Arytaina punctipennis* from Peradeniya on *Indigofera*; *Trioza fletcheri* from Coimbatore in galls on *Trewia*; *T. jambolanae*, n. sp., from Pusa on *Eugenia jambolana*.]

D'ABREU, E. A. . The Food of Birds in the Central Provinces. (*Rec. Nagpur Museum*, No. II.) [Numerous records of insects taken as food.]

DAS, BASHAMBAR . The Aphidæ of Lahore. (*Mem. Ind. Mus. vi, No.* 4, pp. 135-274, 4 figs., tabs. 13-30.)

DE, M. N. . . Anatomy of Silkworm and Moth. (Grihastha Publishing House, Calcutta.)

DISTANT, W. L. . Rhynchota, Vol. VII. Homoptera; Appendix Heteroptera; Addenda. (*Fauna of India* series, pp. 210, 90 figs.)

DUTT, H. L. . The Greasy Surface Caterpillar; its life-history and seasonal history. (*Agricl. Journ. Bihar & Orissa* v, 1-14.) [Deals with *Agrotisypsilon* in Mokameh area.]

FAWCETT, J. M. . Notes on a collection of Heterocera made by Mr. W. Feather in British East Africa, 1911-13. (*Proc. Zool. Soc.*, 1917, 233-250, tab. 1.) [*Nyctipao acuta*, n. sp., from Hills E. of Toungho, Burma.]

FELT, E. P. . . Indian Gall Midges (Cecidomyiidae, Dipt.). *Entl. News*, xxviii, 369-372). [*Hormomyia ischaemi*, Kieff., redescr.; *Dyodiplosis andropogonis*, n. sp., Bellary.]

FLETCHER, T. BAINBRIGGE *Icerya purchasi* in Ceylon: a warning to India. (*Agric. Journ. India*, xii, 525-531, tab.)

" " . Report of the Proceedings of the Second Entomological Meeting held at Pusa on the 5th to 12th February 1917. Pp. xii, 340, 34 cold. tabs.; Govt. India Press.

" " . Report of the Imperial Entomologist. (*Sci. Repts. of the Agricl. Res. Inst., Pusa, 1916-17*, pp. 71-90.)

FLETCHER, T. BAINBRIGGE Report of the Imperial Pathological Entomologist. (*loc. cit.* pp. 91-102.)

" " . Agricultural Entomology. (*Annual Report Board. Sci. Advice for India, 1916-17*, pp. 78-95, 149-158.)

FLUTIAUX, E. . . Nouvelle liste de Cicindelidæ de l'Indo-Chine. (*Bull. Soc. Ent. France*, 1917, 368-370.) [Includes a few Indian species].

FRASER, F. C. . . The female of the Dragonfly, *Brachythemis fuscopalliata*, Ris. (*Bombay Nat. Hist. Soc. Journ* xxv, 282-283, tab.)

" " . . Two new Indian Dragonflies. (*l. c.*, 383-386.) [*Phyllomacromia nilgiriensis*, n. sp., Nilgiris; *Hylaeothemis fruhstorferi*, Kby., redescr., Nilgiris.]

" " . . Indian Dragonflies. (*l. c.*, 454-471, tabs. i-xiii.) [General introduction; structure; habits.]

" " . . The influence of the Monsoons on Insect Life in India. (*l. c.*, 511.)

" " . . Indian Dragonflies, Part II. (*l. c.*, 608-627, 13 figs.)

GIRAULT, A. A. . A new *Embidobia* from India. (*Entom.* l, 152-153.) [*E. brittanica*, n. sp., from eggs of *Embia major*.]

GOOT, P. VAN DER . Aphididæ of Ceylon. (*Spolia Zeylan*, xi, 70-75 figs.) [List of species collected by Rutherford; *Macrosiphum minutum, Greenideoida ceyloniæ* n. spp.]

" " . . Notes on some Indian Aphides. (*Rec. Ind. Mus. xiii, 175-183, 6 figs.*) (Six new spp.)

GRANDI, G. . Contributo alla conoscenza degli Agaonini (Hymenoptera, Chalcididae) di Ceylon e dell' India (*Ann. R. Scuola sup. d'Agricoltura in Portici* (2) xiv (sep. pag.) pp. 1-54, 20 figs.) [Chalcids from fig fruits. *Eupristina grassii*, n. sp., from Peradeniya, pp. 38-45, figs.; *E. saundersi*, n. sp., pp. 45-48, figs., from Calcutta, in fruits of *Ficus religiosa* and *F. retusa nitida*.]

HAMPSON, SIR G. F. . Descriptions of new Pyralidae of the sub-families Hydrocampinae, Scoparianae, etc. (*Ann. Mag. Nat. Hist.* (8) xx, 265-282.) [*Piletocera maculifrons, P. discisignalis, P. flavidiscalis*, n. spp., Khasis; *P. metochrealis*, n. sp., Ceylon (mont.).]

HAMPSON, SIR G. F. . Descriptions of new Pyralidæ of the Sub-family Pyraustinæ. (*l.c.*, 369-384.) [*Tabidia fuscifusalis*, n. sp., Ceylon (Ratnapura) p. 376; *Marasmia euryterminalis*, n. sp., Formosa and Khasis, p. 378.]

" " . Descriptions of new Pyralidæ of the Sub-family Pyraustinæ. (*Ann. Mag. Nat. Hist.* (9), i, 125-136.) [*Lamprosema*, Hb., supersedes *Nacoleia*.]

HAMPSON, SIR G. F. . Descriptions of new Pyralidæ of the Su-famy. Pyranstinæ. *l.c.*, 265-280). *Sylepta ochrotichroa*, n. sp., Khasis, p. 266].

HOLMGREN, K. AND N. . Ropert ona Collection of Termites from India. (*Mem. Dept. Agric. India* (*Entl.*), v, pp. 137-171, one fig.)

HOWLETT, F. M. . Notes on Head and Body-lice and upon temperature reactions of lice and mosquitos. *Parasitology*, x, 186.)

HUNGERFORD, H. B. . The life-history of *Mesovelia mulsanti*. White (*Psyche*, xxiv, 73-84, figs., bibliogr.)

ILLINGWORTH, J. F. . *Clerada apicicornis* sucking blood. (*Proc. Hawaii Entl. Soc.*, iii, 274).

INGLIS, C. M. . . . Fight between *Vespa cincta*. Fabr., and *Polistes hebræus* Fabr. (*Journ. Bombay Nat. Hist. Soc.* xxv, 511).

INGRAM, A. AND SCOTT MACFIE, J. W. Notes on some distinctive points in the pupæ of West African Mosquitos. *Bull. Entl. Res.*, viii, 73-91, figs.). [Pupa of *Culex fatigans* described].

JOICEY, J. J. AND KAYE, W. J. New species and forms of Sphingidæ. (*Ann. Mag. Nat. Hist.* (8) xx, 305-309). [*Marumba irata*, n. sp., Tibet; *oxyambulyx cyclasticta*, n. sp., Burma; *D. citrona*, n. sp., Sabathu].

KENNEDY, C. H. . . Notes on the Penes of Zygoptera (Odonata) No. 3. The Penes in *Neoneura* and Related Genera. *Entl. News*, xxviii, 289-294, 3 tabs.) [A few Indian species are dealt with].

KUNHIKANNAN, K. The Coffee Borer. (*Mysore Agric. Calendar* 1918, pp. 7, 10-11, 14; 6 figs.)

LAIDLAW, F. . . . A list of the Dragon flies recorded from the Indian Empire, Pt. II. (*Rec. Ind. Mus. xiii 321-348, 7, figs. 13-15*). [Revision of sections *Podelestes Platyenmis, Platysticta,* and *Protoneura* of Agrionidæ].

LAMB, C. G. . . . Notes on Exotic Choropidæ, Part II. Oscininæ (*Ann. Mag. Nat. Hist.* (9) i, 329-348, 385-399, 33 figs.) [*Aprometopis minima,* n. sp., Coimbatore, larva in rotten cholam stems, *Scoliophthalmus obliquus,* Becker, Coimbatore, p. 331 ; *Sc. micans,* n. sp., Coimbatore, pp. 331-2, figs. 1, 2 ; *Meroscinis foveata,* pp. 333-334, figs. 3-5; *M. Planiscutellata,* p. 335, figs. 6-8, n. spp., Peradeniya ; *Dactylothyrea hyalipennis.,* Meij., Peradeniza, p. 337 ; *Siphunculina funicola,* Meij., "eye-fly". Singapore, Coimbatore, Ceylon, p. 344 ; *Siph, intonsa.* n. sp., Peradeniya, pp. 345-346, fig. 17 ; *Anatrichus erinaceus.* Loew, var. *pygmaea* nov., Peradeniya, p. 348 ; *Melanochæta flavofrontata,* Beck., Yercaud ; *Hippelatus nigricornis.* Thoms., var. *bilineata.* Meij., *H. minor,* Meij. ?, H *ocellata,* n. sp., Peradeniya, pp. 387-388 ; *Lasiopleura zeylanica,* n. sp., Peradeniya, pp. 388-389, f. 20 ; *Gampsocera mutata* var. *grandis,* var. nov., Peradeniya, p. 390, f. 21 ; *Cestoplectus,* n. g., pp. 390-2, *intuens,* n. sp. Peradeniya, p. 392, ff. 22-25].

LICHTENSTEIN, J. L. . Observations sur les Coccinellides mycophages. (*Bull. Soc. Ent. France,* 1917, 298-302). [Bibliography].

MARSHALL, G. A. K. . *Platymycterus,* a new genus of Asiatic Curculionidæ. (*Ann. Mag. Nat. Hist.* (9) i, 245-252). [*Platymycterus,* n. g., type *Corigetus feæ* Fst., pp. 245-246 ; key to species ; *P. feæ,* Fst., Burma, Assam, p. 248 ; *P. deceptor,* n. sp., Kumaun, pp. 248-249 ; *P. himalayensis,* n. sp., Kulu. p. 249 ; *P. moestus,* n. sp., India, p. 250 ; *P. kashmirensis,* n. sp., Sonamarg. p. 251 ; *P. sjöstedt* n. sp., Dehra Dun, Pusa, Chota Nagpur, pp. 251-252].

MAULIK, S. . . . Variation in the prothoracic species of *Dactplispa xanthopus.* Gestro. (*Ann. Mag. Nat. Hist.* (9) i. 70-74, figs.) [Specimens from Darjiling.]

MAULIK, S. . . . Note on *Episticia reicheana*, Guerin. (*l. c*, pp. 74-76, fig.)

" . . . Note on *Laccoptera vigintisex-notata*. Boheman. (*l. c.*, 318-322, 3 figs.)

" . . . Two new Indian Cassidiæ beeteles. (*loc. cit.*, 322-325, fig.) [*Aspidomorpha chandrika*, n. sp., Darjiling distr., pp. 322-324, fig.; *Asp. spaethi*. n. sp., Nilgiris, pp. 224-325.]

de MEIJERE, J. C. H. . Studien über südostasiatische Dipteren. XIII (*Tijds. voor Ent.* lx, 238-251, figs.) [*Coccodiplosis*, n. g., *pseudococci*, n. sp.; larva on *Pseudococcus crotonis, citri, virgatus* and *adonidum*].

" " . Studien über südostasiatische Dipteren. XIV (*l. c.*, 275-369). [A resumé, in systematic order, of previous papers.]

MEYRICK, E. . . . Exotic Microlepidoptera, Vol. II, Pts. 2-5, pp. 33-160. [Numerous new genera and species from Indian Region.]

" . . . Two new Indian species of *Cosmopteryx*. [*Ent. Mo. Mag.* liii, 257-258.) [*C. phæogastra*, pp. 257-258, *C. bambusæ* p. 258, n. spp., Pusa.]

MISRA, C. S. . . . The present condition of Lac Cultivation in the Plains of India. (*Agricl. Journ. Ind.*, xiii, 405-415 tab. 23, 1 map.)

" . . . Indian Sugarcane Leaf-hopper (*Pyrilla aberrans*. Kirby). (*Mem. Dept. of Agric., India, Entl. Series*, v, No. 2.)

MITTER, J. L. . . . Note on the method of feeding of *Corizoneura* (*Pangonia*) *longirostris*, with a description of the mouth parts. (*Ind. Journ. Me. Res.* v, 523-528, t. 49.)

MUIR, F. . . . The Derbidæ of the Philippine Islands. (*Phil. Journ. Science*. xii, Sect. D., 49-104, 1 tab.) [Many Indian species and genera, keys, etc.]

NARASIMHAN, M. J. . The Fungus Enemies of Green Bug on Coffee. (*Mysore Agric. Calendar* 1918, pp. 43, 46-47; figs. 8-11). [Fungi attacking *Coccus viridis* in Mysore.]

NEWSTEAD, R. . . . Observations on Scale-Insects (Coccidae). IV. (*Bull. Entl. Res.* viii, 1-34, figs.). [*Phenacoccus ballardi*, n. sp., from S. India.]

NEWSTEAD, R. . . . Observations on Scale-Insects (Coccidae). V. (l. c., 125-134). [Numerous records from South India.]

ORMISTON, W. . . . Notes on Ceylon Butterflies. (*Spolia Zeylan.* xi. 1-69, tab. 1.)

PAIVA, C. A. . . . Zoological Results of a Tour in the Far East Aquatic Hemiptera. (*Mem. Asiat. Soc. Bengal*, vi, 77-82, 3 figs.)

" " . . . Aquatic Rhynchota from the Southern Shan States (*Rec. Ind. Mus.* xiv, 19.)

" " . . . Rhynchota from Barkuda Island. (*Rec. Ind. Mus.* xv, 1-16) [*Eusthetus insularis*, pp. 6-7, *Harpator varians*, p. 11, n. spp.].

PANTEL, J. . . . Description de *Carausius* nouveaux (Phasmidae) et notes sur les *Carausius* de l' Inde méridionale. (*Ann. Soc. Ent. France* 1917, 267-306, 12 figs. tab. 2). [*Carausius furcillatus*, n. sp., Shembaganur, pp. 267-274 ; *C. lobulatipes*, n. sp., Shembaganur, pp. 274-277 ; *C. pustulosus*, n. sp., Palnis, pp. 277-279.]

PEILE, H. D. . . . The packing of papered butterflies for safekeeping or despatch by post. (*Bombay Nat. Hist. Soc. Journ.* xxv, 309-312, figs.)

PIC, M. . . . . Nouveaux Cérambycides de la Chine méridionale, III. (*Bull. Soc. Ent. France*, 1917, 353-354.) [*Clytus rufobasalis*, p. 353, *Mesosa glabrofasciata*, pp. 353-4, *Pachyosa albonotata*, p. 354, n. spp., Yunnan.]

PIERCE, W. DWIGHT. . Weevils which affect Irish potato, sweet potato, and yam. (*Journ. Agricl. Res.* xii, 601-611, tabs. 28-34.) [*Cylas formicarius*, *C. formicarius elegantulus*, and *C. turcipennis*.]

PRASHAD, BAINI. . The Thorax and Wing of the Mosquito (*Anopheles*) (*Ind. Journ. Med. Res.* v, 610-640, tabs. 57-61).

PRASHAD, B. . . . The anatomy of a Chironomid larva of the genus *Polypedilum* (*Rec. Ind. Mus.* xiv, 71).

" " . . . The development of the dorsal series of thoracic imaginal buds of the Mosquito, and certain observations on the Phylogeny of the Insects. (*loc. cit.*, 641-655, tabs. 62-66.)

PRONT, L. B. . . New Geometridae in the Joicey Collection. (*Ann. Mag. Nat. Hist.* (8) xx, 108-128, tab. vii.) [Several new Indian spp.]

" " . . New Lepidoptera in the Joicey Collection. (*Ann. Mag. Nat. Hist.* (9) i, 18-32). [*Comibaena hypolampes*, n. sp., Vrianatong, Tibet, pp. 19-20. *Ptochophyle dipyramida*, n. sp., Tenasserim Valley, pp. 22-23.]

RAMACHANDRA RAO, Y. Notes on some South Indian Cecidomyiids causing galls in grasses. (*Journ. Asiat. Soc. Bengal* (n. s.), xiii, 299-306, tab.)

ROBINSON, E. . Coccidae of the Philippine Islands. (*Phil. Journ. Science*, Sect. D, xii, 1-47, 6 tabs.) [Many Indian species and genera, key to sub-families, etc.]

ROEPKE, W. . . . Eenige opmerkingen over twee Javaansche Canthariden, *Mylabris pustulata* Thunb. en *Epicauta ruficeps*, Ill. (*Tijds. voor Ent.* lx, 252-267, figs., tabs. 1, 2). Larvæ predaceous on egg-masses of *Cyrtacanthacris*.]

ROTHSCHILD, LORD . On the genera *Melanothrix Drepanojana*, *Melanergon*, *Paracydas*, *Cotana*, *Eypercydas*, *Epicydas*, and *Nervicompressa* of the Family Eupterotidae, with descriptions of new forms. (*Novit. Zool.* xxiv, 463-474, tabs. 11-12.) [*Melanothrix inter, media*, n. sp., Mergui, *M. leucotrigona*, Hmpsn., *M. nicevillei*, Hmpsn., p. 464.]

" " . . Some new moths of the Families Arctiidae and Eupterotidae. (*loc. cit.*, 475-492). [*Tagora pallida*, n. sp., Khasis, *Apona cashmeriensis major*, n. sp., Sikkim, p. 486 : *A. frater*, n. sp., Khasis, *Pseudojana pallidipennis grandis*, n. subsp., Shan States, p. 487.]

SAHASRABUDDHE, D. L. The Spice Gardens of Sirsi in Kanara. (*Bombay Dept. Agric. Bull.* 83.) [Insect pests of Cardamom, pp. 46-48.]

SCOTT, F. B. . . Notes on *Papilio demoleus*. [at Rawal Pindi] (Entom. l, 238-239).

SENIOR-WHITE, R. . A note on Lymantria ampla, Wlk. (*Spol. Zeylan.* xi, 76-80, 1 tab.)

" " . On colour shades and wing markings of *Euproctis semisignata*, Wlk. (*loc. cit.*, p. 83).

SINTON, J. A. . . A Trematode parasite of Anopheline Mosquitoes (*Ind. Journ. Med. Res.* v, 192-194, t. 30).

" " . . The Anopheline Mosquitoes of the Kohat District. (*loc. cit.* 195-209, 1 diagram.)

SOPARKAR, M. B. . A Trematode parasite of Anopheline Mosquitoes (*Ind. Journ. Med. Res.* v, 512-515).

SPEYER, E. R. . . The Fluted Scale, *Icerya purchasi* (*Trop. Agric.* xlviii, 355).

SWINHOE, C. . . New Indo-Malayan species of Lepidoptera. (*Ann. Mag. Nat. Hist.* (8) xx, 157-166.)

" " . New Indo-Malayan Lepidoptera. (*l.c.* 407-412). [*Cyrestis atosia*, n. sp., Maymyo, pp. 408-409; *Neptis ancus*, n. sp., Toungoo, p. 409; Hesperidae, *Tecupa*, n.g., pp. 410-411; *Tecupa curiosa*, n. sp., Naga Hills, p. 411; *Amsacta saduca*, n. sp., Cuddapah, p. 412.]

TETLEY, H. . . The structure of the mouth-parts of *Pangonia longirostris* in relation to the probable feeding-habits of the species. (*Bull Ent. Res.* viii, 253-267, 10 figs., tab. 6.)

THEOBALD, F. V. . Notes on new and little known British Aphides (*Entom.* li, 25-29). [*Callipterus ononidis*, Kelt.= *Chaitophorus* Buckt., reported on lucerne in India.]

TILLYARD, R. J. . . The Biology of Dragonflies. (Cambridge University Press, pp. xii, 396; 4 tab., 188 figs.)

TOTHILL, J. D. . . Some new species of Tachinidae from India. (*Bull. Ent. Res.* lx, 47-60, 16 figs.)

TOWNSEND, C. H. T. . Indian Flies of the sub-family Rhiniinae. (*Rec. Ind. Mus.* xiii, 185-202), (12 gen. nov., 16, n. spp.)

TUNSTALL, A. C. . The spraying of Tea in North-East India. (*Agricl. Journ. Ind., Sci. Congr. Number*, 1918, 73-80.)

TURNER, R. E. . . On a Collection of Sphecoidea sent by the Agricultural Research Institute, Pusa, Bihar. (*Dept. Agric., Entl. Mem.* v, 173-205.) [Numerous records and descriptions of novelties.]

" " . . Notes on Fossorial Hymenoptra, XXXI. On Psammocharidae in the British Museum. (*Ann. Mag. Nat. Hist.* (8) xx, 357-360.) [*Ceropales pernix*, *C. albovariegata* and *C. claripennis* of the "Fauna" referred to *xanthampulex*.]

TURNER, R. E. . . Notes on Fossorial Hymenoptera. XXXII. On new species in the British Museum. (*Ann. Mag. Nat. Hist.* (9) i, 86-96.) [*Elis tricolor*, Smith, subsp. nov. *longiceps*, Dibrugarh, subsp. nov. *shuckardi*, India, pp. 87-88; *Sphex lutaria*, Fb., Gyangtse, p. 88; *Sphex* (*Psammophila*) *mahatma*, n. sp., Tibet and Sikkim, pp. 88-89; *Sphex* (*Parapsammophila*) *erythrocephala*, Fb., note on structure, pp. 90-91; *Sphex haimatosoma*, Kohl, *S. basalis*, Sm., from Karachi, p. 91; *Sphex punctata*, Sm., from Gyangtse, p. 91; *Tachytes diversicornis*, n. sp., Karachi, p. 94.]

" " . . Notes on Fossorial Hymenoptera, XXXV. On new Sphecoidea in the British Museum. (*Ann. Mag. Nat. Hist.* (9) i, 356-364, fig.) [*Spilomena indostana*, n. sp., Bombay distr., p. 358; *Philanthus ramakrishnae*, n. sp., Bababudin Hills, pp. 361-362; *Trachysphex fulvicornis*, n. sp., Chapra, p. 363; *Trypoxylon fletcheri*, n. sp., Shillong, pp. 363-364.]

WALKER, J. J. . . Note on *Trogoderma khapra*, Arrow, a recently described Dermestid granary pest. (*Ent. Mo. Mag.* liii, 165). [Found in Kent in barley from Karachi.]

WASMANN, E. . . Myrmekophile und termitophile X Koleopteren aus Ostindien. Paussidae und Clavigerinae. (*Tijds. voor Ent.* lx, 382-408, 3 tabs.) [*Paussus assmuthi*, Wasm., t. 5 f. 1; *P. jerdani* Westw., pp. 384-385, t. 5 f. 2, found at Khandala in nest of *Pheidole latinoda angustior*; *Platyrhopalus denticornis*, Donov., pp. 386-387, t. 5 ff. 3-5, found at Khandala in nests of *Pheidole latinoda*; key to sub-genera of *Platyrhopalus*, pp. 392-393; *Fustiger indicus*, n. sp., pp. 399-400, t. 7 f. 11, from Khandala in *Cremastogaster* nest; *Fustigerillus*, n. g., pp. 400-401, *F. fusicornis*, n. sp., pp. 401-402, t. 7 ff. 12, 12a, from Kandala in *Cremastogaster* nest; *Paliger*, n. g., pp. 402-403, *latirostris*, n. sp., pp. 403-405, t. 7 ff. 13, 13a, from Borivli in nests of *Cremastogaster rogenhoferi* and *C. aberrans*; *Fossiger* n. g., p., 405, *assmuthi*, n. sp., pp. 405-407, t. 7 ff. 4, 14a, 14b, from Borivli in nests of *C. rogenhoferi* and *C. aberrans*.]

WATERSTON, J. . . On the Mosquitos of Macedonia. *Bull. Entom. Res.* ix, 1-12, 5 figs.) [Several Indian species.]

WILEMAN, A. E. AND SOUTH, R. New species of Lepidoptera from Japan and Formosa. (*Entom.* l, 145-148.) [*Euproctis Postfusca*, n. sp., from Formosa and India.

WRIGHT, R. E. . . The distance Mosquitoes can fly. (*Journ. Bombay Nat. Hist. Soc.* xxv, 511-512.) [*Cellia pulcherrima* apparently flying ;5½ miles off-shore.]

Forest Entomology.

BEESON, C. F. C. . . Forest Insect conditions in India. (*Agric. Journ. (Ind., Special Indian Science Congress, No. 1918, pp. 114-124.*)

" " . . The Cedar Twig Borer (*Australian Forestry Journal, Jan. 1918, p. 33*).

TOTHILL, J. D. . . Some new species of *Tachinidae* from India. (*Bull. Entomological Research, ix, part 1, May 1918, pp. 47-60, figs. 1-16.*)

Veterinary Science.

AVERY, R. F. . . Periodic Opthalmia (*Jnl. of Amer. Vety. Med. Assoc. li, 1917, 78.*)

BOYNTON, W. H. . A disease in cattle in the Philippine Islands similar to that caused by Anaplasma marginale, Theiler. (*Philippine Jnl. of Science, Section B, xii, 1917, 281.*)

BELIN . . . Traitement des lymphangites epizootique et ulcereuse par l'auto-pyotherapie. (*Bull. de la Soc. Cent. de Méd. Vét., lxx, 1917, 346.*)

BROGAN, G. H. . . Notes on Contagious Bovine Pleuro-Pneumonia in Northern Rhodesia. (*Vety. Jnl. lxxiii, 1917, 369.*)

BRUCE, E. A. . . A new parasite for cattle. The Larvæ of Eristalis tenax L. (Drone-Fly). (*Jnl. of Amer. Vety. Med. Assoc., lii, 1917, 66.*)

CHRISTOPHERSON, J. B. Notes on a case of Espundia (Naso-oral Leishmaniasis) and three cases of Kala Azar in the Sudan treated by the Intravenous Injection of Antimonium Tartaratum. (*Jnl. of Trop. Med. & Hyg., xx, 1917, 429.*)

CASTELLANI, A. . . Notes on tropical Diseases met with in the Balcanic and Adriatic Zones. (*Jnl. of Trop. Med. & Hyg., xx, 1917, 214.*)

CLARK, H. C. . Piroplasmosis of cattle in Panama. Value of the brain film in diagnosis. (*Jnl. of Infec. Dis., xxii, 1918, 159.*)

DARWENT, E. N. . . Notes on a case of Ulcerating Granuloma treated by Intravenous Injections of Tartar Emetic. (*Trans. of the Soc. of Trop. Med. & Hyg., x, 1917, 198.*)

DRUMMOND, H. . . On the treatment of a series of recently inflicted War wounds with Flavine. A report to the Medical Research Committee. (*Lancet, Vol. II—1917, p. 640.*)

DANYSZ, J. . . Transformation des arsenobenzenes et leur action sur l' organisme. (*Annales de l' Instt. Past.* xxx*i, 1917, 483.*)

H. E. H. . . . A night trek through the "Fly" Belt. (*Vety. Jnl. lxxiii, 1917, 401.*)

HALL, M. C. . . A discussion of some Principles of Anthelmintic Medication. (*New Orleans Med. Jnl., lxx, 1918 637.*)

" " . . Notes in regard to Horse Lice, *Trichodectes and Haematopinus.* (*Vety. Jnl., lxxiv, No. 3, 87.*)

JOHNSTON, E. L. . . On some peculiar bodies found in the blood of certain African Snakes. (*Jnl. of Trop. Med. & Hyg., xx, 1917, 241.*)

JEMMA, R. . . Brief Historical notes on the introduction of antimony in the therapeutics of Internal Leishmaniasis. (*Jnl. of Trop. Med. & Hyg., xxi, 1918, 1.*)

KENNEDY, J. C. . . Six cases of Kala Azar, their treatment with Intravenous Injections of Tartar Emetic. (2) Notes on the Epidemiology. (*Jnl. of R. A. M. C., xxx, 1918, 209.*)

KOPACZEWSKI, M. W. . Sur le venin de la Murène (Mu oena helena L.) (*C. R. de l'Acad. des Sc. clxv, 1917, 513.*)

" " . Recherches sur le sérum de la Murène (Muroena helena L.) La toxicité et les propriétes physiques des sérum. (*C. R. de l' Acad. des Sc., clxv, 1917, 600.*)

LENEVEU . . . L'urémie d' origine acarienne chez le Cheval. (*Rec. de Med. Vet., xciii, 1917, 477.*)

LEIPER, R. T. . . Two Helminthological Notes. (*Trans. of the Soc. of Trop. Med. and Hyg., p. 194.*)

LINCH, CHAS. . . Details to be observed in making a Tuberculin Test. (*Jnl. of Amer. Vety. Med. Assoc. lii, 1917, 56.*)

LAVERAN, A. . . Boutons d' Orient experimentaux chez un *Cercopithecus mona*, multiplication des boutons primaires par auto-inoculations. Le. *C. mona* et un mangabey, morts au cours d'infections cutanées, ne presentent pas trace d'infection viscérale. (*Bull. Soc. Path. Exot., xi, 1918, 130.*)

LEGER, M. . . Parasites sanguicoles d'Oiseaux de la Guyane. (*Bull. Soc. Path. Exot, vi, 118, 124.*)

MC CASKEY, G. W. . The Complement Fixation test in the Diagnosis of Tuberculosis with a study of 135 cases. (*Amer. Jnl. of Med. Sc., cliv, 1917 648.*)

MOORE, R. C. . . Treatment of Equine Pneumonia. (*Jnl. of Amer. Vety. Med. Assoc., lii, 1917, 47.*)

MOHLER, J. K. . . Vesicular Stomatitis of Horses and Cattle. (*Jnl. of Amer. Vety. Med. Assoc., lii, 1917, 410.*)

NICOLLE, C. . . De l' emploi du cobaye comme animal réactif pour le diagnostic experimental de la rage des rues. (*C. R. Soc. Biologie, lxxx, 1917, 788.*)

PRITCHARD, L. E. . A Report on Contagious Necrosis in the Horse. (*Vety. Jnl., lxxiii, 1917, 396.*)

RENDLE SHORT, A. . Report on Wound treatment by Brilliant Green paste. (*B. M. J., Vol. II, 1917, 506.*)

RIJNBERK . . Anthrax Bacillus Meningitis. (*Jnl. of Trop. Med. and Hyg., xxi, 1918, 8.*)

REMLINGER, P. . . Presence du virus dans la rate du Cobaye rabique. (*C. R. Soc. Biologie, lxxx, 1917, 789.*)

RICHET, C. AND CARDOT, H. Des antiseptiques reguliers et irreguliers. (*C. R. de l' Acad. des Sciences, clxv, 1917, 491.*)

RAILLIET, A. . . Nématodes parasites du Congo belge. (*Bull. Soc. Path. Exot., xi, 1918, 82.*)

RAILLIET, A. AND HENRY, A. Sur un Strongylide vivant dans des kystes intestinaux chez les grands Félidés. (*Bull. Soc. Path, xi, 1918, 86.*)

" " Un Bunostomien pathogéne, parasite de la vesicule biliaire d'un Rongeur Africain (*Bull. Soc. Path Exot., xi, 1918, 93.*)

TORRES, O. . . A case of destructive Leishmaniosis. (*New Orleans Med. Jnl., lxx, 1918, 666.*)

TEAGUE, O. AND CLARK, H. C. A Trypanosome of Panamanian Cattle and a Method for Concentrating Trypanosomes in Peripheral Blood. (*Jnl. of Infec. Dis., xx, 1918, 154.*)

TRIBONDAU, L. . . Note sur la coloration des bacilles tuberculeux par le procédé de Ziehl-Neelsen. (*C. R. Soc. Biologie, lxxx, 1917, 780.*)

VÉLU, H. . . . La Septicémie Contagious due Porc au Maroc- (*Bull. Soc. Path. Exot., xi, 1918, 177.*)

WATSON, E. A. . . Report on Ulcerative Cellulitis-Ulcerous Lymphangitis. (*Vety. Jnl, lxxiii, 1917, 382.*)

WATKINS PITCHFORD, H. An Enquiry into the Horse Disease known as Septic or Contagious Pneumonia. (*Vety. Jnl., lxxiii, 1917, 345.*)

WILLIAMS, W. L. . The Avenue of Invasion and the Behaviour of the Infection of Contagious abortion in the Uterus. (*Jnl. of Amer. Vet. Med. Asso., lii, 1917, 13.*

YUILL, J. L. . . A Method of Staining Blood-films. (*Jnl. of R. A. M. C., xxx, 1918, 227*).

Medical Research.

LANE, CLAYTON . . Final Report on the Ankylostome Inquiry in the Darjeeling District of India. (*Indian Journal, Medical Research, v, No. 2.*)

AWATI, P. R. . . Report on Studies in Flies. Classification of the Genus *Musca* and Description of the Indian Species. (*Indian Journal, Medical Research, v., No. 1.*)

" " . . Report on a new Larviporous *Philæmotomyia*, (*Philæmatomyia indica*, n. sp.) (*Indian Journal, Medical Research, v, No. 3.*)

ROGERS, LEONARD . Report on two years' Experience of Sodium Gynocardate and Chaulmoograte subcutaneously and intravenously in the treatment of Leprosy. (*Indian Journal, Medical Research, v, No. 2.*)

GREIG, E. D. W. . Report on observations on the effect of Intravenous Injections of Antimonium Tartaratum on Malarial Parasites. (*Indian Journal, Medical Research, v, No. 1.*)

GREIG, E. D. W. . Report on summary of the results of the observations on the treatment of Oriental Sore by Antimonium Tartaratum. (*Indian Journal, Medical Research, v, No. 2.*)

GREIG, E. D. W. AND RITCHIE, W. D. A Note on Intravenous Injections of Mercuric Chloride in the treatment of enlarged spleen. (*Indian Journal, Medical Research, v, No. 2.*)

GREIG, E. D. W. AND MAITRA, G. C. Observations on the occurrence of Hyphomycetic Elements in ulcers of the skin in 19 cases (*Indian Journal Medical, Research, v, No. 3.*)

MACADAM, W. AND KEELAN, R. The Problem of the Amœbic Dysentry carrier in India and Mesopotamia. (*Indian Journal, Medical Research, v, No. 1.*)

INDEX.

A

B

C

D

E

F

G

H

I

J

K

L

M

N

O

P

R

S

U

W

Departmental Publications.

I.—METEOROLOGICAL DEPARTMENT—

Government of India Office.

(1) The Indian Daily Weather Report and Chart.

(2) The Weekly Rainfall Summary.

(3) The Monthly Weather Review.

(4) The Annual Summary.

(5) The Rainfall of India.

(6) Indian Meteorological Memoirs.

Bengal Office.

(1) Bengal Daily Weather Report and Chart.

(2) Monthly Rainfall Tables and Summaries of the chief feature of the weather of the month over Bengal.

Bombay Office.

(1) Bombay Daily Weather Report and Chart.

(2) Monthly Abstracts of the Bombay observations (*Bombay Gazette*).

Madras Office.

(1) Bombay Daily Weather Report and Chart.

(2) Monthly Rainfall Tables (*Madras Gazette*).

Allahabad Office.

(1) Monthly Weather Summaries (*United Provinces Gazette*).

(2) Annual Summary.

(3) Monthly Rainfall Tables (*United Provinces Gazette*).

Lahore (Simla) Office.

(1) Monthly Summary } of Punjab weather.
(2) Annual Summary }

II.—GEOLOGICAL SURVEY.

The publications of the Department include—

Palæontologia Indica arranged in series, and sold in parts which are priced at 4 annas (6 pence) per plate.

Memoirs, Vols. I—XLIII, including the larger papers on geological subjects.

Records, Vols I—XLVIII, including the shorter papers and Annual Reports from 1868 to 1915, sold in parts, price one rupee each.

Manual, Guides and Maps.

A complete list of the contents of these publications can be obtained by application to the Registrar, Geological Survey of India, 27, Chowringhee Road, Calcutta.

Indexes to the Genera and Species described in the *Palæontologia Indica* up to 1891 to the Memoirs, Vols. I—XX, and to the Records, Vols. I—XXX, have been printed for sale.

III.—SURVEY OF INDIA.

(1) Annual General Report.

(2) Professional Papers.

IV.—BOTANICAL SURVEY AND ROYAL BOTANIC GARDEN, CALCUTTA.

(1) Annual Report of the Botanical Survey of India.

(2) Records of the Botanical Survey, Vols. I—VIII.

(3) Annual Report of the Industrial Section, Indian Museum.

(4) Annual Report of the Royal Botanic Garden, Calcutta.

(5) Annals of the Royal Botanic Garden, Calcutta, Vols. I—XII.

A list of the contents of the Records and of the Annals with prices of the numbers and volumes still available can be obtained by applying to the Superintendent, Royal Botanic Garden, Calcutta.

V.—Department of Agriculture.

(1) Annual Report.—An account of the year's work of the Imperial Department, including the separate reports of the scientific officers of each branch (Agricultural Chemistry, Botany, Mycology, Entomology, and the like).

(2) The Agricultural Journal of India.—A quarterly journal containing articles on agricultural matters intended for the educated agriculturist and the general reader interested in agriculture.

(3) Scientific Memoirs of the Department of Agriculture.—An occasional publication for papers of a scientific or technical nature divided into series such as Chemical, Botanical, Entomological, and the like.

(4) Bulletin.—An occasional publication containing information on agricultural matters of a temporary nature.

(5) Leaflets.—Short notes of practical instruction in agricultural matters, dealing mainly with Entomological subjects.

VI.—Forest Department.

(1) Review of Forest Administration in British India by the Inspector-General of Forests (issued annually).

(2) Annual Progress Report of Forest Administration in each Province.—Issued by the Local Governments annually.

(3) Indian Forest Records.

(4) Indian Forest Memoirs.

(5) The Indian Forester.—A monthly Journal of Forestry, Agriculture, Shikar and Travel. This is a Departmental Journal, published monthly.

(6) Bulletins are published from time to time.

VII.—Zoological Department.

(1) The Annual Report, 8vo.

(2) The Records of the Indian Museum, 8vo. Containing short papers on Indian Zoology. One or two volumes issued annually in quarterly parts.

(3) The Memoirs of the Indian Museum, 4to. Containing monographs and other important papers. Published at irregular intervals.

(4) Descriptive Catalogue of Indian Decapod Crustacea, 4to. Parts published at irregular intervals.

(5) Descriptive Catalogue of Indian Echinodermata, 4to. Parts published at irregular intervals.

VIII.—Civil Veterinary Department.

(1) Annual Report.

S.G.P.I.—8 D.B.S.I.—8-4-19—724.